

BOTANICAL TRACTS,

By Dr. *HILL*,

VIZ.

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| 1. Usefulness of a Knowledge of Plants. | 4. The Origin of Proliferous Flowers. |
| 2. Outlines of a System of Vegetable Generation. | 5. The Sleep of Plants. |
| 3. The Origin of Double Flowers. | 6. The History and Virtues of Valerian. |
| | 7. An Account of the Mushroom Stone. |

To which are added

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| 1. The Method of Propagating Trees by their Parts, by Mr. <i>T. Barnes</i> , a Correspondent, | 2. The Practice of Gardening, by Mr. <i>T. Perfect</i> , a Pupil of Dr. <i>Hill</i> . |
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Publish'd at various Times.

Now first Collected together.

L O N D O N:

Printed for R. BALDWIN, in *Pater-noster-Row*, 1762.

THE
USEFULNESSES
OF A
KNOWLEDGE of PLANTS:

ILLUSTRATED

In various Instances, relating to MEDICINE,
HUSBANDRY, ARTS, and COMMERCE.

WITH

The easy MEANS of INFORMATION.

By J. HILL, M. D.



LONDON:

Printed for R. BALDWIN, in *Pater-noster-row*; and
J. JACKSON, in *St. James's-Street*.

M. DCC. LIX.

THE
USEFULNESS
OF A
KNOWLEDGE of PLANTS.

INTRODUCTION.

THE frivolous pursuits in which some have engaged, under the name of Enquiries into NATURAL KNOWLEDGE, and which the incurious world have been content to distinguish by the same title, have brought that useful science to disgrace: The VIRTUOSO has been considered as a NATURALIST, and the FLORIST has been honoured with a name derived from BOTANY. If the credit of that study were
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all, it would be easy to pass over this in silence; but more than those who love the science are interested in the consequences: it is in many instances necessary to the convenience, and in some to the very being of mankind: the world therefore owes the subject more respect than to confound it with the amusements of an idle, though innocent curiosity.

THE knowledge of plants, in particular, is of so various and important use, that the Publick would perhaps do wisely to provide there should be always some persons who made it their immediate care. Such a knowledge may be useful in a high degree to MEDICINE, to AGRICULTURE, and to ARTS and COMMERCE; for plants are essentially concerned in all these: and certainly the greater advantages will be obtained in them, the more the objects are understood. May I be permitted to add a fourth great article in which this study has an high utility? a consideration indeed superior to them all: 'tis PIETY. He who can see the wonders of their form, and not adore the hand that made them, deserves not

not the character of a rational being ; nor does he much less degrade himself, who sees them, and is silent. In these, altho' the humblest of his works, we see the great Creator clearly and distinctly ; and while we view their growth, they raise the mind to heaven.

So far as MEDICINE depends on plants, a knowledge of them is essential equally to its SUCCESS in the present practice, and to its ADVANCEMENT by new and useful discoveries. Who shall depend upon the virtues of an herb, a root, or seed, when it is impossible he should know whether he really takes them ? or how shall the physician judge of their effects, who is not sure that they were given ? yet this uncertainty is too justly founded upon the present ignorance and inattention of the several ranks through whose hands all preparations must pass between the physician's prescription and the patient. We see in simple medicines of this kind the abuse is great ; doubtless in compounds it is greater : nor is the mischief confined even within these bounds. Tradition tells the mother of a family this herb or that will cure the disorders of her

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children ;

children; but she is deceived when she makes the trial; for something else is sold under its name.

ROMAN WORMWOOD will cure indigestion; for it is an aromatick, warm, and cordial medicine; but no such herb is brought to market: they sell SEA WORMWOOD, a nauseous bitter, in its place, and the true medicine, though possessed of all its virtues, has thus lost much credit. All this time there is no plant more hardy than true ROMAN WORMWOOD, none more easily propagated in the open ground: but the physician overlooks the abuse; and long neglect has made the other an universal substitute.

MR. DAVIES, on the great success of the the BARDANA in the gout, took for three weeks, in vain, a nauseous infusion of the root of COMMON BLUNT-LEAV'D DOCK. This had been dug up to sell under the name of the SHARP-POINTED DOCK, famous in scorbutick cases; and by a second abuse was palmed upon the purchaser under this other name.

A few months since, the YOUNGER MR. DELAVAL acquainted me he had been
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using the BLACK BRYONY ROOT externally for a fixed disorder in his side, by the prescription of DR. JAMES ; but without any effect. Enquiring into the symptoms which would have necessarily appeared upon the application of that medicine, I found he had felt nothing of them ; and on producing the root, it appeared he had been all the time using the WHITE BRYONY ; a plant, though idly called by the same generical term, yet altogether different in its virtues.

THE inner bark of the small shrub FRANGULA, is a cathartick equal to any of the foreign drugs, and is peculiarly excellent against obstinate cutaneous disorders. I ordered this to a person who had such a complaint ; and they sold him, in its name, the bark of COMMON ALDER, an astringent.

TO a poor person perishing under a jaundice, I directed the DULCAMARA, a medicine superior to all others in the last stage of that disease ; and she received instead of it the COMMON NIGHTSHADE. This might have been of fatal consequence ; for the dose of the other is so large, that
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an equal quantity of this must needs have been destructive. Both these abuses rose from errors of the same kind : We call the Frangula, Black Alder ; and the Dulcamara, Woody Nightshade. They were to blame who introduced this corruption of names ; but that is too established to be altered : the care must now be to make them understood. The knowing plants distinctly is the immediate business of those who keep shops for the sale of them ; and the meanest servant who is allowed to officiate, should be compelled also to learn their differences. These are instances in which my particular care in seeing the plants, saved the lives of those who were to have taken them : may we not justly think many are lost where the abuse is not discovered.

TENDERNESS for names prevents my mentioning some other instances : but they are needless, for the abuse is in a manner universal. WHITE MAIDENHAIR has virtues greater than all its kind, but FERN is sold constantly under that name ; tho' the plant itself is common.

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THE true wild VALERIAN, eminently useful in nervous disorders, was no where to be had, before the fraud of selling a wrong kind was shewn : but now the shops are full of it ; physicians find its original excellence, and the drug has recovered its long-lost estimation.

THE roots of the common double-flowered PIONY, are sold for medicinal uses : whereas the physicians direct only those of the simple kind, called for distinction the Male Piony ; and experience shews these alone have the full virtue. Nay it is not long since that in the place of the common DROPWORT, an esculent root, the HEMLOCK DROPWORT was brought to one who wanted it ; the most fatal of all the English poisons.

WE see some plants of little efficacy, and others of different qualities from those intended, are sold under their several titles : nay sometimes such as are destructive. Under the name of BUGLE, an excellent sub-astringent and balsamick, they sell VIPERS BUGLOSS, a detergent of more power than

is generally known ; for the BLACK HOARHOUND, an anti-hysterick medicine, they sell the WHITE HOARHOUND, a pectoral ; for LITTLECELENDINE, useful against the piles, GREAT CELENDINE, good in disorders of the eyes ; and for the true BLACK HELLEBORE, famous for many virtues, and no harsh medicine, they sell always the Greenflowered BASTARD HELLEBORE, or the GREAT SETTERWORT ; giving to infants, a violent medicine inwardly, whose proper use is externally for cattle.

By this fault the success of medicine, so far as it depends on plants, is rendered precarious ; and from the same cause improvement in that branch is become impossible. In England the roots of GOLDEN ROD have been found excellent against the gravel ; and those of the LONG CYPERUS, a cure for dropfies, in the stages wherein that desperate disease is curable : but tho' this knowledge comes upon fair authority, how shall it be confirmed ? He who shall attempt to try the virtues of these roots, will probably find some other thing sold in their place ; and it will be supposed they have

have not the virtue which has been attributed to them, because that root has not the same which ignorance or fraud has substituted in their stead.

FROM the savages of North America we have heard, that the root of MOUNTAIN AVENS will cure agues, in the manner of the bark ; and probably this is true : for the same virtue has been attributed by many writers to the COMMON AVENS of our hedges. Perhaps it lost this credit unfairly, by some other root being sold for it : but where is the chance that it now should be restored ? From the same quarter of the world we receive intelligence of a LOBELIA, distinguished by a peculiar quality in the cure of the venereal disease ; and that the COLLINSONIA, a plant some years since received into our Gardens, and named from one who does great honour to this study, possesses virtues for the relief of the disorders of pregnant women superior to all other remedies.

THESE several plants we may raise in any quantities ; and there is fair ground
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to hope the art of healing may be greatly improved by them : but they must first be known ; and these abuses must be removed before 'tis possible we should enjoy the benefit. The BARK itself came to our knowledge the same way ; and we want other Medicines of such Power : America may produce them ; indeed there appears reason to believe it does : but unless the knowledge of that part of nature, whence they are obtained, be more regarded, there is little chance of our receiving the full benefit.

IF from medicine we turn our eyes to AGRICULTURE, the prospect is the same : great advantages are in our reach ; but if we neglect to understand the subjects, we shall lose them.

ALL know how lately we are become acquainted in England with what are called the ARTIFICIAL GRASSES, plants raised by tillage for the food of Cattle ; nor is there any one who disputes the vast advantage our husbandry has received from them. The number we have of these at present, tho' much

much larger than was known to our forefathers, is yet very limited, and the great benefit wou'd be variety. It will be easy to add, where so much has been discovered ; and to apply to Britain what Linnæus has advanced in Sweden.

NATURE has not confined this source within narrow bounds : it is our ignorance alone which makes it seem so. We find that even in kingdoms farther north than ours, the peasants have introduced many plants yet unknown to our farmers ; and there are wild about our hedges others which might be cultivated to a vast advantage. The YELLOW MEDICK WITH WREATHED PODS, which grows neglected on our waste grounds, is the new plant now cultivated so successfully in Sweden : the farmers, indeed the whole country, are enriched by it, and the character under which it stands recorded in their publick acts is *Omnium omnino præstantissimum pabulum*, ALTOGETHER THE MOST EXCELLENT OF ALL FOOD FOR CATTLE. There is no disputing their testimony, who have so much experience, nor is there any reason

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why we should not share the benefit in Britain.

THE KIDNEY VETCH, and LADIES MANTLE, eminent for the nourishment they afford ; the first to sheep particularly, the other equally to those creatures and to cows ; are wild in gravel-pits, and by road sides : but they are unknown in our pastures, unless by accident, and then unregarded ; while they are both ready to grow from seed scattered among the grass of hilly and barren closes ; encreasing the quantity of food tenfold ; and improving it in the same proportion.

THE CHICHLING VETCH, which rises in our damp thickets, is capable of giving the same benefit to wet marshy lands ; perhaps even to bogs : but no farmer knows it. Melilot, though not regarded for this purpose, wou'd, in the same degree, enrich an open pasture ; and the BURR REED, of our ditches, might fill the wet moors with food for our horned cattle, for no plant is so readily eaten by oxen ; nor is there any one more wholesome.

AMONG

AMONG the articles useful in the arts, and objects of our commerce, it is not conceived what benefit might arise from a more perfect knowledge of their nature. Many of the most considerable are native of our own country ; tho' neglected here, and sought at a large price abroad : and we have others which might supply the place of some that are imported, perhaps to better purpose. To instance only among those subservient to dying.

THE French exceed us in their BLACK for cloths: and from many circumstances there is reason to believe, they owe the advantage to a wild plant, as common here as it can be with them ; it is the LYCOPUS, or WATER HOARIHOUND : it has been early said, tho' now neglected, that this plant yielded a peculiar and distinguished black : and such limited experiments as I have had opportunity to make, confirm it. 'Tis certain the French gather this herb carefully, which we suffer to perish useless ; nor is there any other purpose known, to which they can apply it.

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WE bring Canary weed, a dry brown moss from that remote country, to use in our red colours : but we have rocks and barren hills at home covered with a moss of like nature ; and as it should seem of many times its value.

IN Sweden red is dy'd with the roots of SQUINANCY WORT, yellow with the bark of BUCKTHORN and BLACK ALDER ; and red with the SAW-WORT as we do yellow with the Safflower ; little unlike the other but in colour. All these are weeds, or wild-hedge-shrubs with us : and why should not every one have a fair trial ? Perhaps the Society for the encouragement of Arts and Commerce, the best ever instituted in our country, may raise the spirit of this improvement by their premiums : but who shall assure the industrious mechanic that he has the right plants ? 'tis ten to one against him, wheresoever he attempts to buy them.

THAT the Sick are frequently defrauded of their cure, and perhaps sometimes destroyed by the abuses of those who deal in herbs, is most certain. But how shall they
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who sell them be instructed better? or who shall shew the former what that MEDIC is; or what those other plants he is advised to cultivate? Where shall the dyer learn what is the true SAW-WORT, or who shall tell him the distinction between BUCKTHORN and BLACK ALDER; the very berries of which last shrub, are often sold for those of the other, even to the apothecaries.

GREAT as the disadvantages and mischiefs are which arise from the present want of information; the remedy is easy. Galen prescribed it in his time, when he saw the same necessity. It is the “teaching those who are concerned; not by flight words, or vague representations, but by the plants themselves; raised in some small spot for that single purpose.” The learned may study them in books; but there is none so low in mind, who would not know them by the things themselves, presented growing to his eye, and explained upon the spot before him.

THIS spot should be planted with every herb useful in medicine, in the arts, or husbandry; and should be open always, free of expence;

expence, and to all people : and there should be some person present to shew what was desired to be seen, and to explain what was necessary to be known.

FROM a spot thus planted, and thus calculated for plain utility, science need not be banished ; nor indeed ought : because upon its principles alone, are established those absolute distinctions which prove the error or the fraud of common practice ; and which would render all mistake, and future deception, equally impossible.

THE plants raised for this service, would appear as conspicuous to the common eye, when disposed in the regular classes of the modern botany, as any other way ; and to the student they would be much more distinct, and plain in all their differences. Whatever could be done by a classical distribution of the shrubs and flowers in more extensive plantations, may be executed even with these humbler kinds ; and the purposes at once of the student and the publick, fully answered.

PLANTS would be known with certainty, from seeing them so disposed, and hearing them clearly and usefully explained. Great care should be taken to shew distinctly the different kinds which ignorant custom, or inconsiderate writers, have called by the same general name: there should be shewn together, with each plant, what other species were most like it; and there might be added always in some near border, the thing usually sold under its name. This would be fixing the whole subject upon the memory, even of the unlearned.

THE nature and qualities of plants might here be pointed out in presence of the objects; and their value shewn, not only so far as is known, but in those farther advantages which might reasonably be expected from them. The garden would be a kind of living herbal; in which it might be easy to explain, in a distinct order, what each plant was, whence it was brought, and how distinguished from all others; what virtues it possessed, and for what services it was proper. A lesson too short to load the memory; and too regular to be misunderstood. Those who studied the nature of

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vegetation for the assistance of the arts of culture, might there see a vast variety of plants in every season, subjected to all rational experiments; manures of every kind might be experienced fairly; and the arts, the means, and objects of improvement in our husbandry, all shewn at once. The curious would have the advantage of seeing, in a single view, the various useful products of the several parts of Europe: and even more nice enquiries might be here turned to use: for it is not impossible that in many cases, what one plant does well, another species of the same kind may effect yet better. Why should we suppose that he who, probably by accident, made the discovery of the use of any plant, has always chanced to try the most effectual kind.

A LITTLE spot would answer all these purposes; and such a garden might be supported at small expence. Till that shall be established; the Author of the Proposal will take a pleasure in giving this information to all who want it at his own garden. Let none fear to apply, the plants are there; and every one is welcome.

F I N I S.

O U T L I N E S

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Vegetable Generation.

By Dr. J. H I L L.

Illustrated with FIGURES.

L O N D O N :

Printed for the A U T H O R ;

And to be had of R. BALDWIN, in *Pater-noster-row* ;
T. OSBORN, in *Grays-Inn* ; G. SEYFFERT, in *Dean-*
street, Soho ; and R. WATKINS, Optician, at
Charing-Cross. M D C C L V I I I .

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Vegetable Generation.

By Dr. J. H I L L.

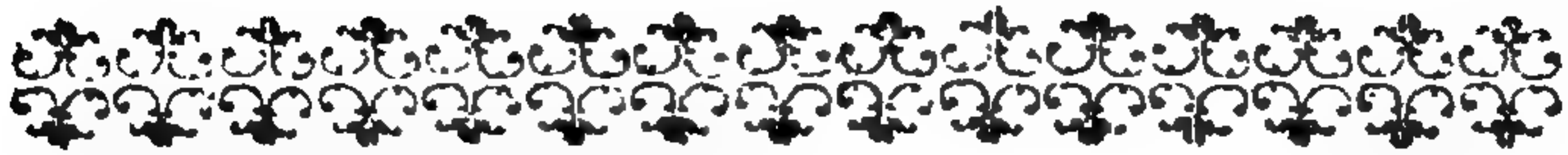
Illustrated with F I G U R E S.

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Charing-Cross. M D C C L V I I I .

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OUTLINES

OF

Vegetable Generation.



The DESIGN.

THE purpose of this work is to attempt, on principles not before established, and from the construction of parts hitherto overlooked, or too lightly regarded, an explanation of the PRODUCTION OF PLANTS.

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SINCE the generation of animals, after so many experiments and dissections, is yet obscured by many difficulties, we cannot expect swift advances in the discovery of that of vegetables ; in which the parts are smaller, their office is less known, and their dissection much more difficult.

No more is attempted here than to lay down the sketch or first design of a method, in which this subject may, perhaps, be traced successfully : outlines which the ingenious are invited to assist in filling. The course of nature is here followed (faithfully, if imperfectly) only in one plant ; and what advances are made, have been the result of a few months observation under a single hand : years, perhaps ages, are required to pursue it thro' the several orders of the vegetable system.

ONE plant alone is examined to avoid perplexity : others will be easily sub-
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jected to the like enquiry ; and they will either confirm this system, or establish a better. Truth will be one way or other found.

EVERY discovery, however small or imperfect, is an advance in knowledge ; and has its Value. One new and just observation is worth all the systems that ever were invented. I know how to reverence the FLORENTINE and SWEDE ; but I shall here regard what no author writes : only what nature offers to the sight, on due inspection.

THE Enquiries I have attempted have been made with caution ; and I shall be content to proceed slowly. The search being after truth, all conjecture has been banished, till the principles are known : and the little I may have discovered, which is published as an inducement only to prosecute the subject, is laid down in terms plain to the unlearned. The gardiner may do more than

the philosopher in this point ; for he has the means of constant observation.

THERE are many things in which plants and animals agree ; but there are also several in which, for obvious reasons, they cannot but differ. Analogy, therefore, may be useful ; but it must be pursued with limitations, or it will mislead.



C H A P.

C H A P. I.

THE GENERAL STRUCTURE OF
VEGETABLE BODIES.

TO understand a part of any subject well, it is necessary to have a just idea of the whole. The organs employed by nature in the generation of plants, are the immediate objects of this research : but they cannot be perfectly known till we are acquainted with the rest of the vegetable construction.

A plant is an organized body, endued with a power of growth, and a kind of life ; but without sensation.

PLANTS consist of five parts: 1. The outer bark. 2. The rind. 3. A vascular series. 4. The fleshy substance. 5. The pith.

THESE are common to all plants, trees and the most tender herbs, only differing in

consistence. They are most distinct where they are most firm, as in the woody kinds ; and least where they are most tender, as in the thick stalks of bulbous rooted plants. In these the inner parts often resemble sponges filled with water ; and are only distinguished by the gradations of colour.

THE several organs of generation are formed, by continuation only, from one or other of these parts.

THE parts are always arranged in the order here laid down ; the bark outermost, and the rest in that regular succession.

THE root draws nourishment from the earth ; and the stalk conveys it to the flower. In the flower are placed the organs of generation. These are generally understood to consist of the FILAMENTS, with their ANTHERÆ, and the STYLE with its STIGMA, and RUDIMENT of the fruit : but there
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are other parts equally worthy notice. These not having been sufficiently observed, the system of generation has been imperfect.

I propose to trace these several parts in a plant, in which they are all large and conspicuous; tho' the latter have not been before observed in it.

THIS plant is a species of AMARYLLIS; it is distinguished from the rest by the drooping position of the FILAMENTS, and is a native of the American islands*.

THE root is a bulb: the stalk is naked and a foot high. The leaves are grassy, but of some breadth; the flower is composed of six petals, and has so many FILAMENTS with a single STYLE.

THERE is nothing in this plant singular or uncommon: the parts are plain and simple; therefore they will be easily traced:

* *Amaryllis Spatha multiflora, corollis campanulatis æqualibus, genitalibus declinatis.* Linn. Sp. 293.

they are very conspicuous ; and they will, probably, be found of the same structure in the generality of others. See Pl. I.

THE Bulb is the covering and defence of the young plant : its fibres properly are the roots. The coats of the large part are like those films which enclose the young shoot in the buds of trees, and are destined only to that purpose.

THE stalk is thick, a little flattened, and hollow : a tranverse segment of it represents an elliptic ring, with a large aperture. In this the five distinct parts of vegetable construction, before enumerated, may, with due care, be traced : and this best of all by maceration and dissection.

THE outer bark is redish and filmy : the rind is green and thicker : the vascular series is pale : the fleshy substance is white : and the pith, which surrounds the hollow to



Amaryllis genitilibus declinatis.—
T. Hill del. et Sculp.

a considerable thickness, is perfectly crystalline, and colourless.

THE divisions of these parts are indistinctly marked; but they are absolute. The vascular series is whitish, the fleshy substance white and semipellucid, the pith perfectly clear, and altogether colourless.

THE bark has many fibres: the four other parts are full of bladders and large vessels. The bladders are roundish, but crush'd by pressing one against another: they are smallest in the rind, and larger all the way to the pith, in the inner part of which they are widest of all.

THE vessels are elliptic, and have large cavities. They are continued in an uninterrupted course, from the extreme fibres of the root, to the several parts wherein they terminate. On this structure depends the course of vegetation; which is conducted thus.

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THE root being planted in the ground, where there is heat and moisture, receives nourishment ; which expanding and enlarging the embryo plant, sends it up thro' the surface. A stalk rises, on whose top appears a membranaceous scabbard, containing two flowers : this bursts open, they disclose themselves ; and beneath each is the rudiment of a seed vessel, in which are shells of seeds.

THE plant has now perfected its growth, and must soon after decay : but nature, rather the God of nature, thus prepares a restoration.

THE filmy scabbard formed from the outer membrane of the stalk, having performed its office, fades. The flowers are hardened for the air, and no more need its defence.

THE PETALS, which are six, surround the same number of FILAMENTS, and in the midst of these is the more drooping STYLE.

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THE construction of the stalk is the same with that of the fibres of the root ; and the several parts of the plant follow the like rule.

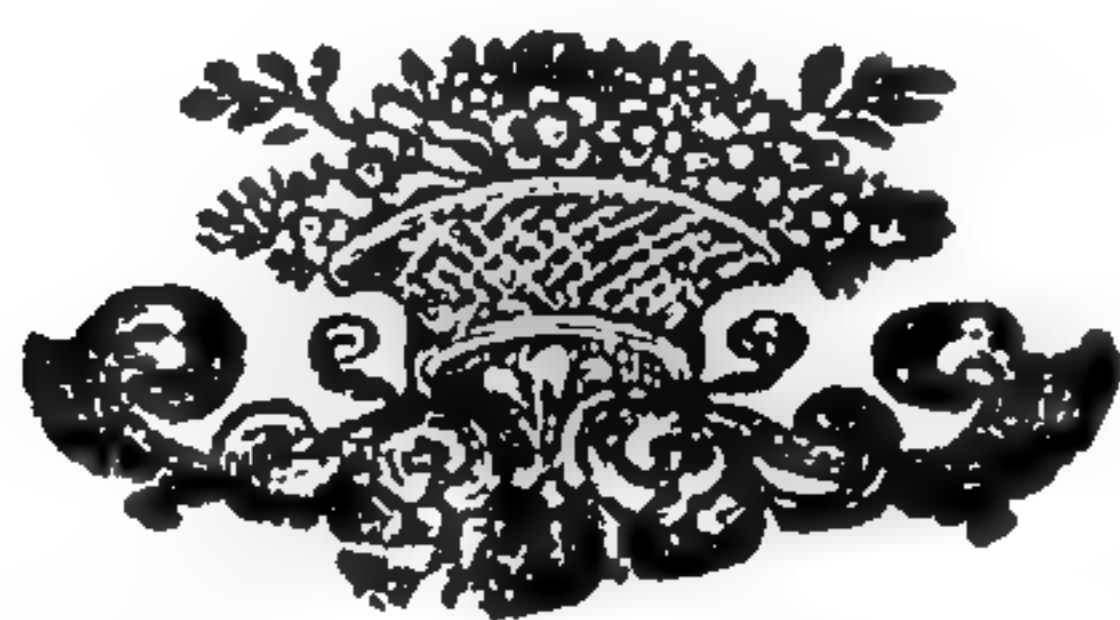
THE principal vessels and fibres of the stalk may be traced, in a strait course, from the extreme pars of the root, to the summits of the six filaments in the flower ; which properly terminate the vegetation. This I have shewn by dissection, and maceration of the parts : and I am extremely obliged to Mr. *Lee*, nurseryman at Hammer-smith, who, for the space of six weeks, from the middle of *February* to the end of *March*, supplied me almost daily with fresh plants in flower for the experiments.

THE fibres of the root are composed, as in all other vegetables, of five substances.

1. AN OUTER BARK, and, 2. an INNER RIND, 3. A SINGLE COURSE OF LARGE VESSELS, 4. A FLESHY SUBSTANCE, and,
5. A.

5. A CENTRAL PITH. Of these five parts, it will be proper to treat distinctly; beginning with the outermost: separating them, and casting them off as we proceed. This way, we shall learn the course and use of the vessels and fibres of each.

THE extreme filaments are the true root of the plant: the Bulb from which they spring, being only, as in other kinds, a covering of the infant shoot; such as the buds of trees, and the bulbs upon the stalks of SAXIFRAGE, and certain LILLIES.



C H A P. III.

THE COURSE, USE, AND TERMINATION
OF THE OUTER BARK.

THE outer bark of the fibres of the root in this plant becomes the outer skin of the stalk, acquiring greenness when it rises into the air.

THIS, after having covered the whole stalk, forms the scabbard of the flowers; and there terminates absolutely: all its fibres and vessels, contracting there, and loosing themselves at its top and edges in closed ends. No part of them are sent into any other substance of the plant.

C H A P.

C H A P IV.

THE COURSE, USE, AND TERMINATION
OF THE INNER RIND.

THERE remain to form the flowers and their foot-stalks only four parts, the inner rind, the single course of vessels, the fleshy substance, and the pith.

THE outer bark being separated, and peel'd off, the inner rind presents itself. Its vessels and fibres proceed in a strait course from those of the root thro' the bulb, and up the whole length of the stalk; at whose summit they divide into two parcels, and form two clusters; each making a knot, from which rises the foot-stalk of a flower. On these parts this rind naturally

turally appears naked, the outer bark having terminated in the scabbard.

THE vessels and fibres may be traced by the help of maceration in these knots. They do not terminate in them, but after a few windings, pass thro' them; and are continued forward up the rind of the foot-stalks.

AT the Top of each Foot-stalk there is another knot or cluster of them; in which, after a few windings, they form themselves into a broader coat. The single course of large vessels appears also on the inner part of them very distinctly.

THEY form together the shell or substance of the seed-vessel, whose rudiment in this plant stands under the flower; and is one continuous substance with it.

All this is form'd by the inner rind of the fibres of the root, continued, under cover,
through

through the stalk, and naked on the foot-stalk, and on the feed-vessel.

FROM the head of the rudiment of the feed-vessel, this rind is continued in a single Body a little way, and then dividing into six parts, it spreads out into the six petals of the flower.

THESE are formed only of the rind of the foot-stalk; and the change of colour is worthy observation. In the root this substance, which is there the inner Rind, is of a reddish brown; in the stalk it is of a strong green; this colour it preserves in the foot-stalks of the flowers; in the rudiment of the capsule it is of a deeper green; in the base of the flower, which is placed immediately above this, it is paler; and thence by degrees, as it ascends the petals, it becomes spotted with red, and afterwards red entirely.

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THE vessels and fibres of this part are very conspicuous in the flower ; and they terminate absolutely at the sides and tops of the petals : as those of the outer rind did in the scabbard.

THUS we see the end of the second coat of the plant ; and there remain the three others entire, for the construction of the several parts of fructification.

C

CHAP

C H A P. V.

THE COURSE, TERMINATION, AND
USE OF THE SINGLE SERIES OF
VESSELS BETWEEN THE INNER RIND
AND FLESHY SUBSTANCE.

IN the construction of the outer bark and of the inner rind, there are mixed with the sap-vessels, fibres in which I have never been able to trace any cavity ; and air-tubes in great abundance : but 'tis not so in regard to the vessels next under, or within the inner rind.

THESE are large and few : they are continued in a regular chain all round the stalk, between the inner rind and the fleshy substance : and there are no other vessels or fibres mixed among them.

THESE I have traced in well macerated, and afterwards in fresh dissected stalks, in an uninterrupted course along the main stem,
thro'

thro' the knots at the division for the origin of the foot-stalks of the flowers, thro' those foot-stalks and thro' the rudiment of the seed vessel, and the solid base of the flower; but they do not run up the petals, those being form'd only of the inner rind.

THESE vessels terminate within the body of the flower, just above its solid base: but they communicate in a wonderful manner by lateral branches with the vessels of the filaments, which run close to them.

THERE is a part in this flower which, tho' extremely singular and elegant, no author has hitherto observed. Linnæus, who has otherwise very correctly given the character of the *Amaryllis*, has not mentioned it: but 'tis easy to know, from his manner in other cases, that when thus pointed out to him, he will call it the *NECTARIUM*, or its several distinct portions, the *NECTARIA* of the flower.

THESE parts are too considerable to have been made without some purpose. It is

but lately the Nectaria of flowers have been known ; and those who did not take them into the account of generation, could not explain it rightly.

IN this Nectarium the single course of vessels terminates : and for its use they are plainly ordained by nature.

WHEN a flower of this plant is perfectly open, if we look steadily into it, we shall see near the base of each petal, between that and the filament, a tuft of feathery matter. See Pl. 1. fig. 1. There are six of these tufts, and they are the parts here treated of : but the filaments, in every view, hide some of them. To obtain a better sight of them, the flower should be cut off transversely at the upper part of its base, just where it begins to divide into petals : thus the petals and filaments being removed, these tufts will appear very distinctly. See Pl. 1. fig. 2

THEY

THEY are colourless in themselves, but they appear greenish from the green base of the flower which is seen thro' them: they are so large and obvious, that one wonders they have not before been observed: they are equal in number to the petals; but they do not rise from these; but in the very clefts formed by their divisions.

THE deeper the parts lie, the more care is required to trace them: but the single course of fibres may be followed from the root up to these six bodies, in which they terminate; as the vessels of the outer rind to the scabbard of the flowers. I have many times done this happily.

ONE of these parts, separated from the base of the flower, I have represented in Pl. 2. as it appears before the microscope. The body of it is hollowed, and the top and sides are jagged. The vessels at the base have formed a continuous substance; but in these parts they separate again, and they terminate in

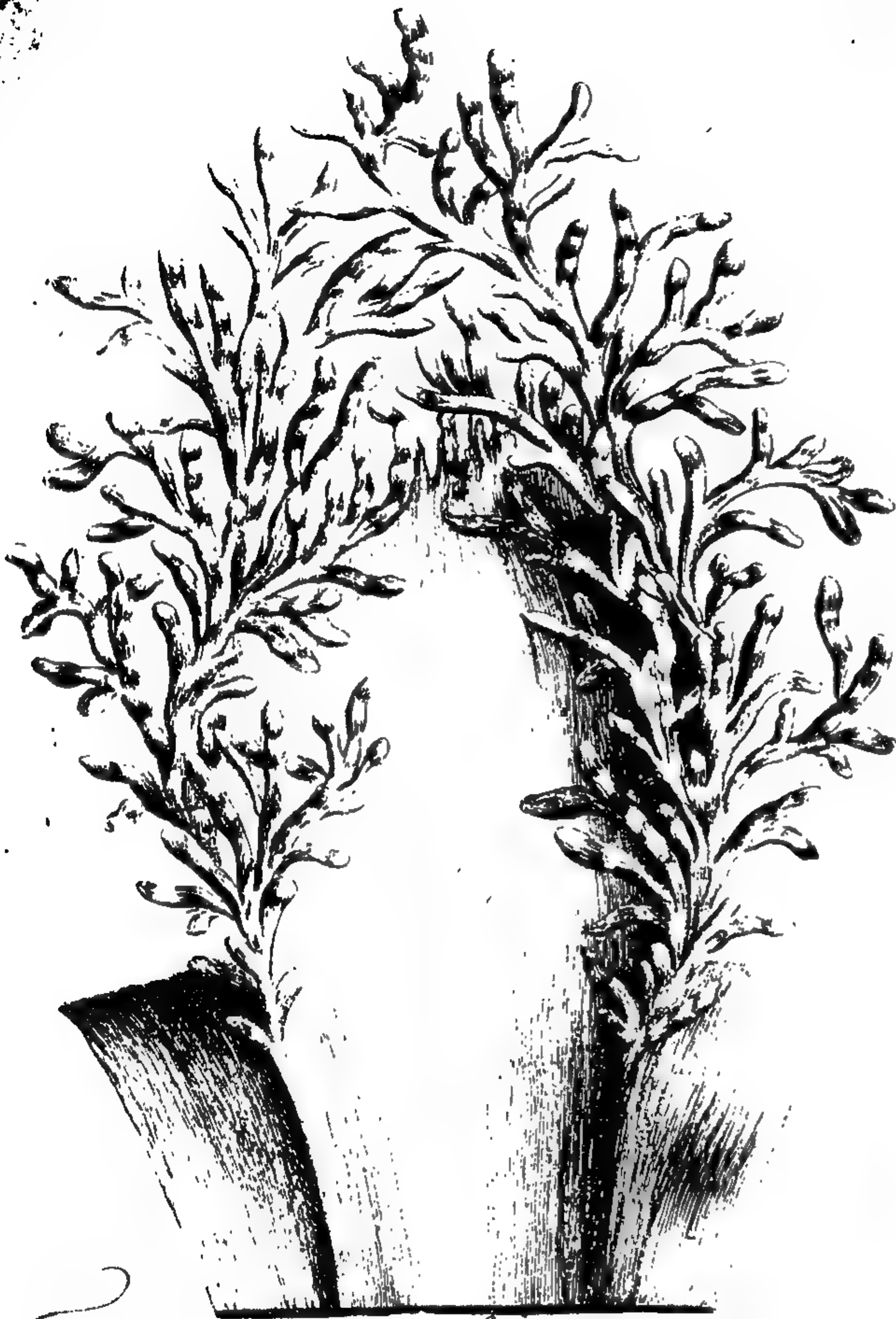
rounded and closed ends, without the least aperture any where.

A microscope of a single lens is best for this examination; and I scarce know a more pleasing object. The whole resembles a piece of fine white coral, but that 'tis pellucid as water. See Pl. II.

WHEN the stalk of the plant is cut transversely, a great quantity of watery juice comes from the mouths of the other vessels: but from these, in particular, there issues a more tough and clammy fluid. This is of a peculiar nature: it is the same in the tufts themselves: It is most tenacious just as the flower is opening; and is at that time also most abundant.

Thus terminate the vessels of the third series.

C H A P.



The NECTARIUM *of the* AMARYLLIS.
Will del et Sculp.

C H A P. VI.

THE COURSE, TERMINATION, AND
USE OF THE FLESHY SUBSTANCE OF
THE STALK.

THE plant being thus cleared of its outer and inner rind, with which last this single course of vessels also usually comes off, the inner parts of the stalk and foot-stalks appear distinctly. The petals and the tufts at the base of the flower being now also removed, there remain only the FILAMENTS and STYLE, in which the vessels of this inner part of the stalk can terminate. To trace these, the whole foot-stalk must be split into thin pieces, and the base of the flower with it.

We have seen distinctly where the inner rind has run up into the petal of the flower; swelling in thickness, and becoming pale, first inwardly, and then entirely; and from that paleness red.

T H E fleshy substance, which constitutes the principal part of the stalk, is easily traced along the foot-stalk of the flower within the green rind ; making also its principal substance. Thence it follows the rind, and the single course of vessels round the rudiment of the fruit : and at its top terminates most distinctly in the six filaments of the flower.

BETWEEN these and the base of the style, there is an absolute space : and the continuation of the fleshy substance of the stalk up the filaments, is most distinctly separated from that organ.

T H E filaments plainly have their origin at the head of the rudiment of the fruit : they run loose and free with their true rounded outline on the inner part : on the outer, they are flatted, and are pressed close towards the thickened portion of the outer rind, where it begins to form the petal. But they are distinctly
and

and most plainly separated from it by the single course of vessels. These accompanying the FILAMENTS and base of the PETALS so far, and serving as an union between them, terminate just above the part where the filaments separate, in those tufted bodies before named.

THE fleshy substance of the stalk being at this part divested of its three coverings, and even of the pith within, forms itself into six assemblages of a rounded outline, and is continued in each nearly to the length of two inches: these are the FILAMENTS.

EACH filament grows smaller toward the top; and at its summit becomes indeed extremely slender.

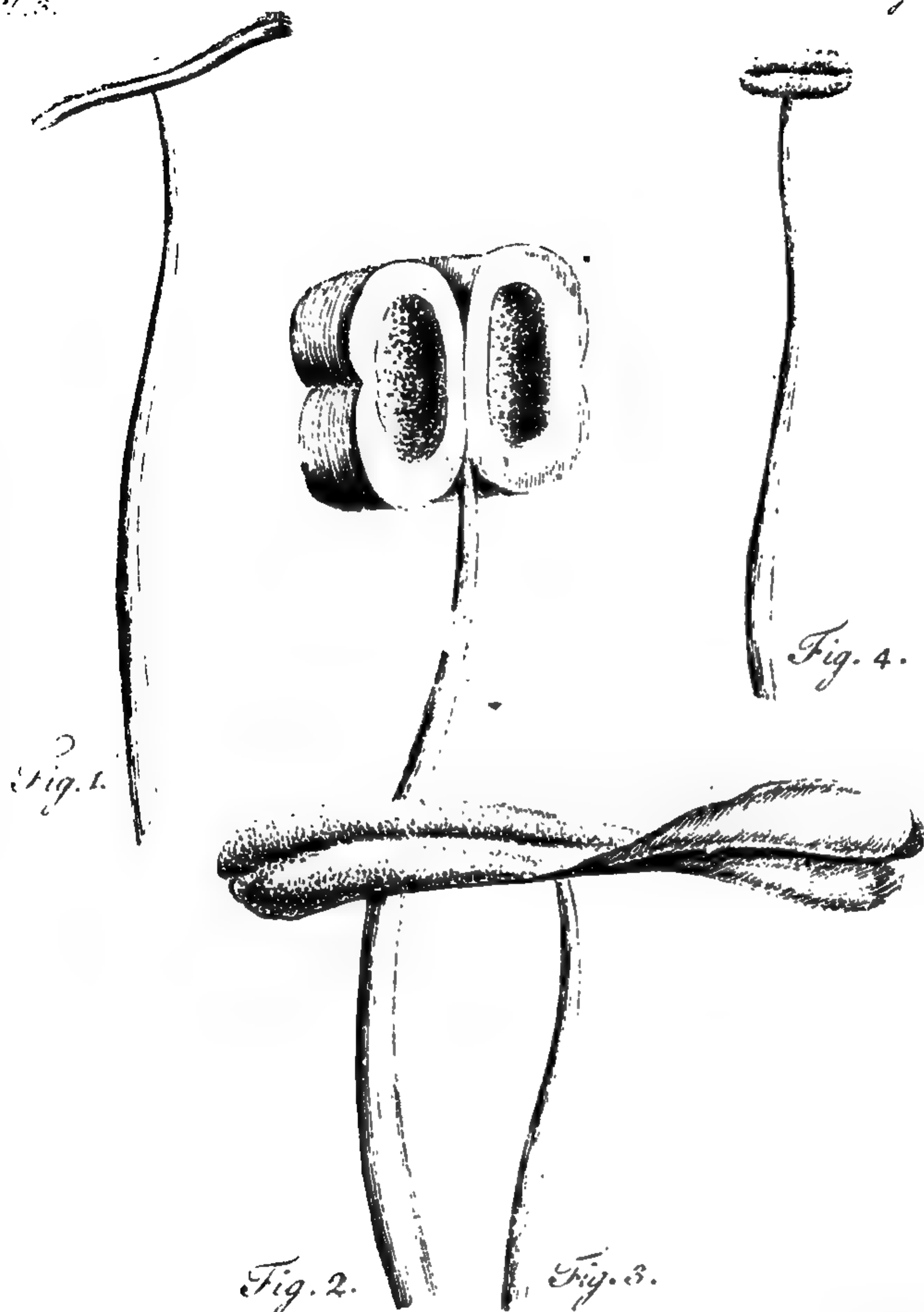
FROM this point the membrane, which had covered it throughout its course, dilates, and forms a regular, large and oblong ANTHERA, white at the first, and considerably long; afterwards shorter and yellow.

THE

THE filament has no hollow, but is composed solely and distinctly of the fleshy part of the stalk: and the same vessels are seen in the stalk and here.

THE ANTHERA, examined with a microscope, appears of a regular and beautiful structure. It is composed of two tubes, laid close to one another, each having a groove in the middle. Its outer rind is white, thick and spongy; and the two cells are full of a yellow powder, which is the farina. See Pl. III. fig. 1. 2.

WHEN the anthera is ripe, each of its tubes bursts at the groove, and the two sides separate and turn back. Fig. 3. In this operation the spongy substance of the tubes contracts itself; by which they become shorter: fig. 4. and the yellow colour is owing to the grains of the yellow farina with which they are covered. If the flowers be carefully watched, this is easily seen; for the operation lasts in each anthera two or three hours.



FILAMENTS of the AMARYLLIS with their ANTHERÆ.

Ill. del. et scul.

I have observed, that the fleshy substance of the stalk is composed of fibrous as well as vascular parts ; and I have found by manifold experience, that this is the essential part of plants : all the buds being productions of it thro' the rind. This has been attributed to the medullary or central substance, but experiments shew otherwise.

THE tubes of the ANTHERA, which are of a loose substance, are formed of the fibrose portion of this fleshy part of the stalk ; and the farina of the vascular.

THE formation of this is the great object of nature in the growth of plants : and the present subject affords an opportunity of tracing it most plainly.

ALL the particles of the farina are of a regular figure and construction. They are the extreme terminations of those vessels which form the fleshy substance of the stalk : and each of these terminates in a minute rudiment of a future

ture plant, carefully and elegantly furrounded with membranes; which defend and preserve it till it comes into the feed-vessel.

THIS is a new doctrine: but it is founded on the plain construction of the parts. That none have established it before, is owing to no one's having pursued the course of the several vessels in plants with attention; or observed this most essential substance, the FARINA, with sufficient magnifying powers.

C H A P.

C H A P. VI.

OF THE FARINA OF THE PLANT.

EACH grain of the FARINA in this plant is an oval body, composed of three parts, a membranaceous covering, a pulpy matter, and a simple but continuous internal substance.

EXAMINED with a powerful microscope, each grain is found to adhere by its larger end to the inner surface of the tube of the ANTHERA : there is an opening where it thus adheres; and this is continued along the body in form of a slight furrow, to the other end.

WHEN the farina is examined by the reflecting microscope in water, the membranaceous covering appears transparent, and the contained substance is continued along its whole length : but it is not nearly equal to the breadth of the covering,

AT

AT the lower end of this is seen, as it were, a little bulb, where it adhered to the anthera: and from this is continued a single waved leaf, grassy and long. See Pl. IV. fig. 1.

THIS is the rudiment of the future plant: it is the extreme termination of the vascular part of the fleshy substance of the root, and stalk; which never terminate any otherwise.

AROUND this minute plant there is collected a vast quantity of tough and semipellucid matter in globules; and it is generally closer pressed at the top than elsewhere, because the farina is there narrower; so that it sometimes resembles a second bulb. Fig. 2.

THIS is the original appearance of the globule of farina: but when it has lain sometime in water, it thus prepares for bursting.

THE whole globule grows shorter, and the included plant, with its pulpy matter, is drawn into a smaller compass. Fig 3. and 4. Soon after, the globule bursts along
 I the

Pl. 4.

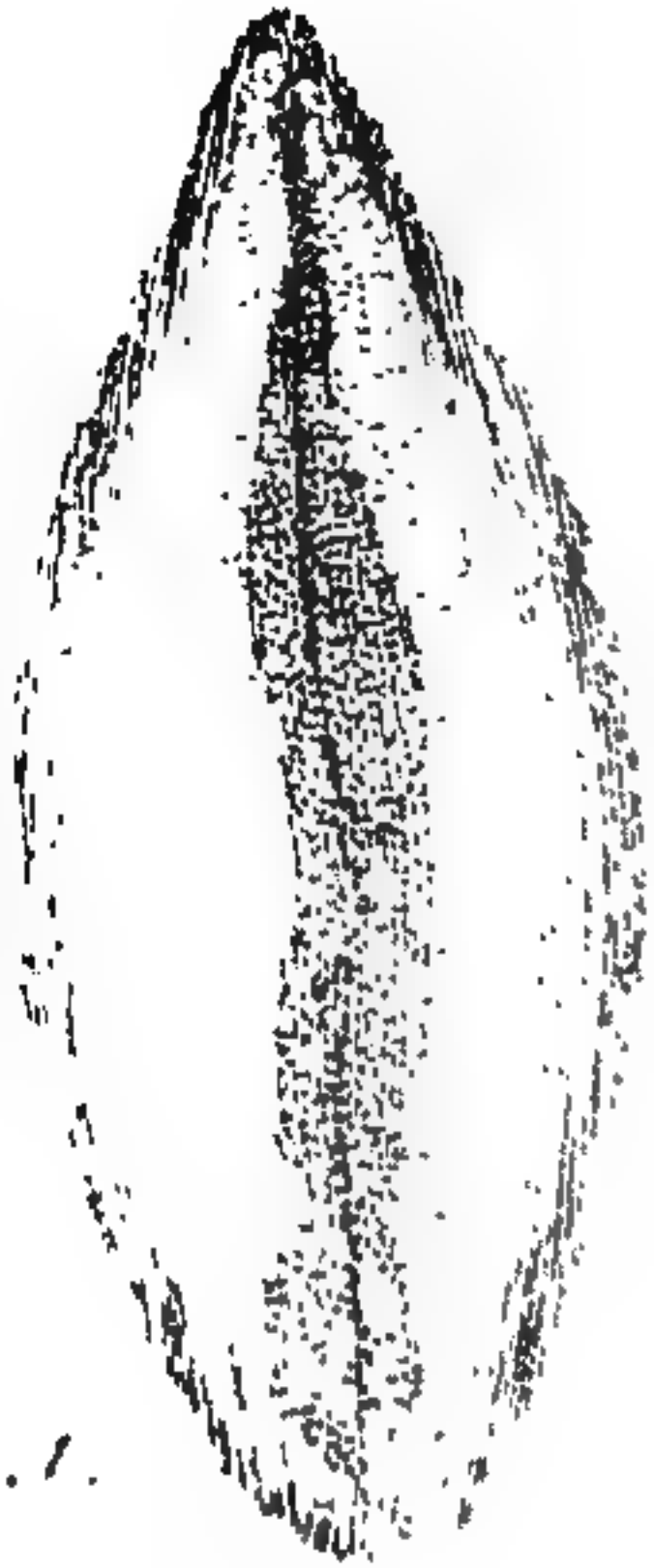


Fig. 1.

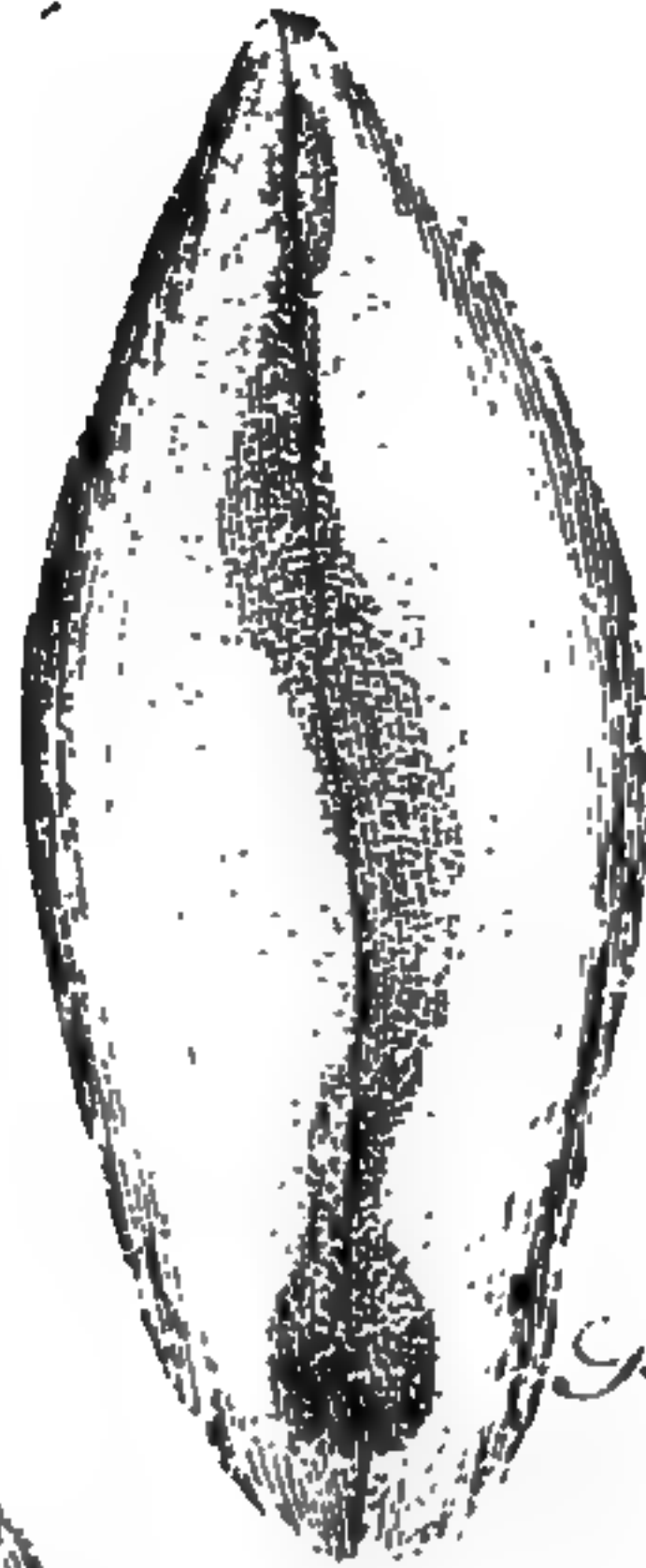


Fig. 2.

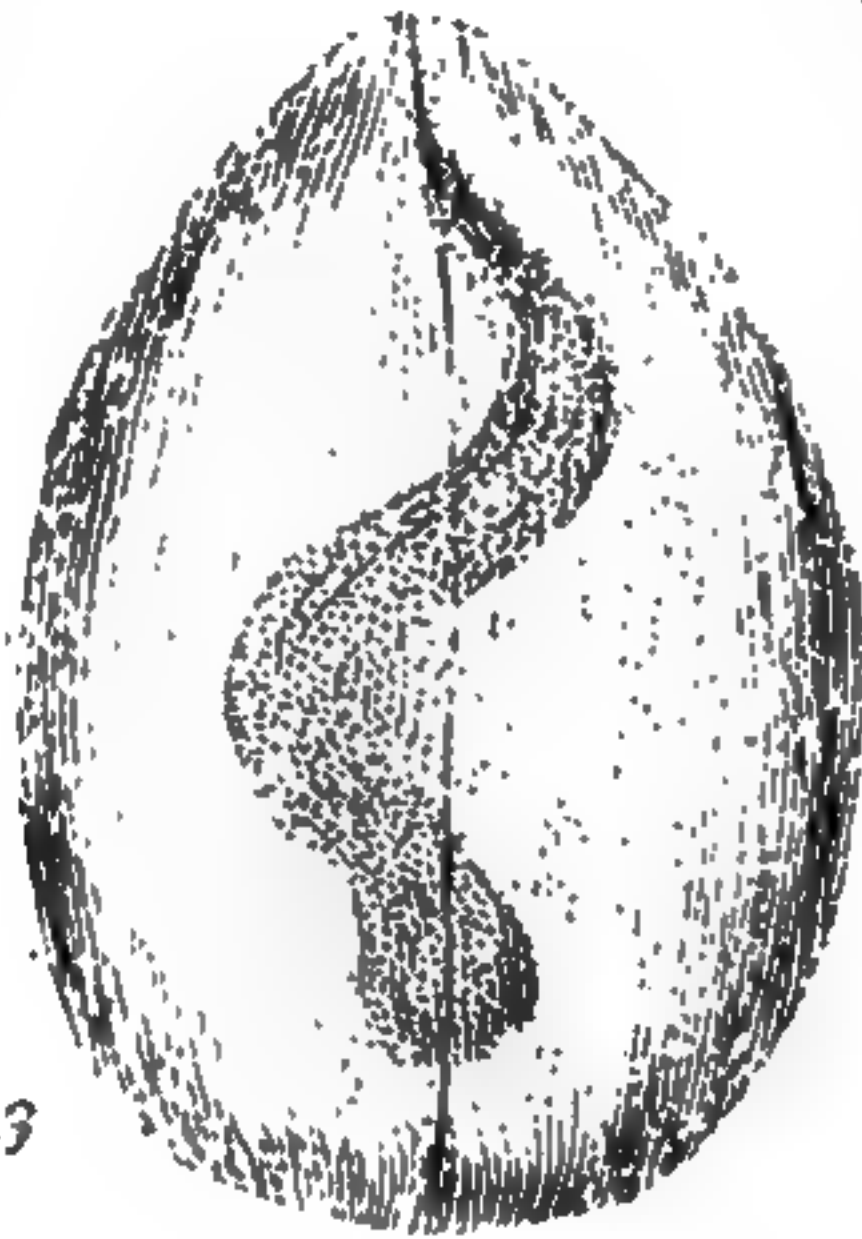


Fig. 3.

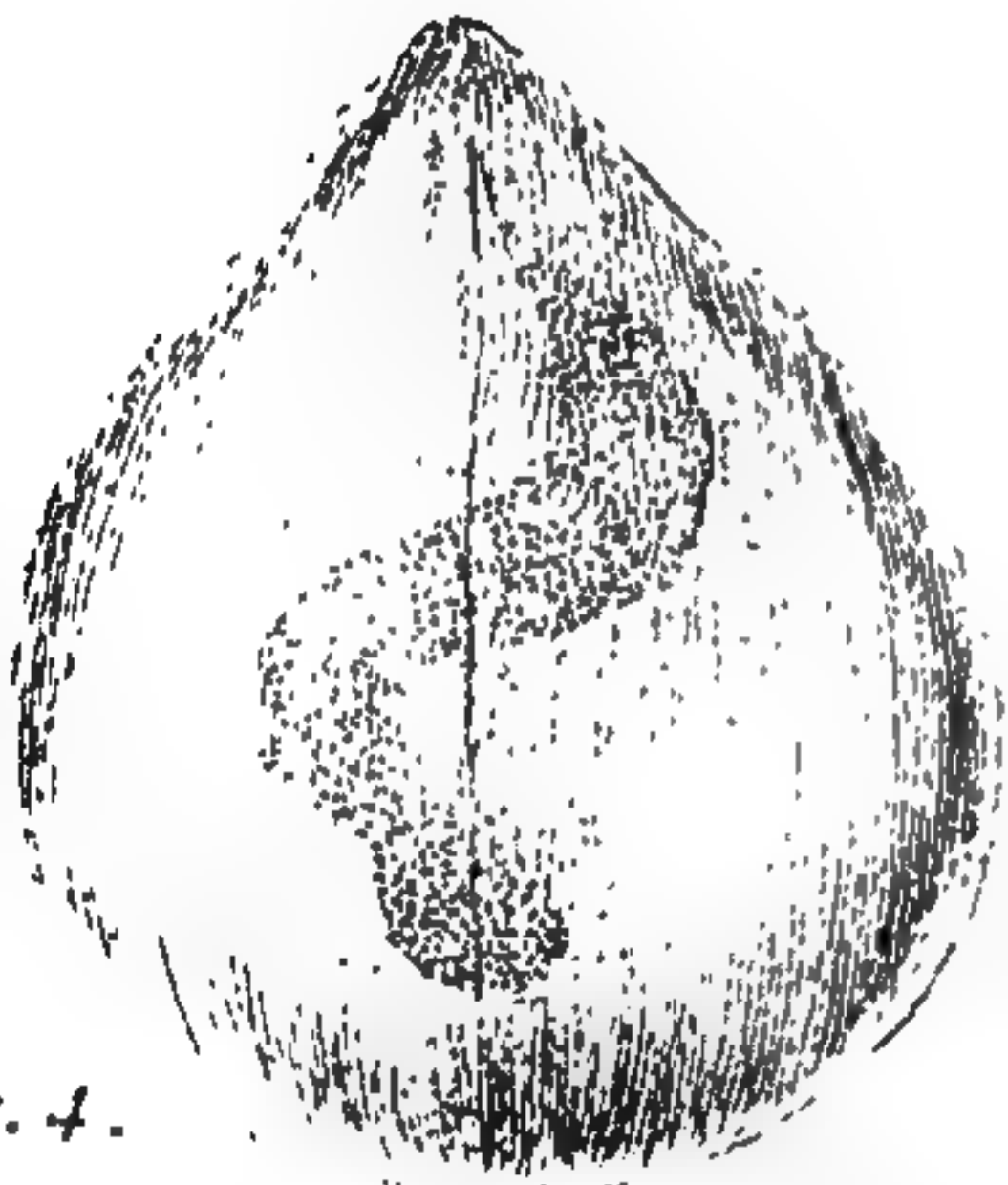


Fig. 4.



Fig. 5.

Varina of the Amaryllis

Will del et sculp.

the furrow, and the rudiment of the future plant, together with its pulpy matter, comes out of it. Fig. 5.

THIS happens in the course of nature ; as well as in water before the microscope : and we shall see presently what becomes of the inclosed substance. First it will be proper to understand perfectly the thing itself.

THE extreme growth of a plant is thus found to be the rudiment of another plant of the same kind : this is enclosed in a membrane, which, I think, is double ; and is placed within a tube at the extreme part of the plant.

IF the rudiment were not thus defended, its tender substance would wither as soon as it was formed.

ALONG the stalk, just over the fleshy part from which this minute rudiment is produced, we see a peculiar course of vessels secreting

a tough matter, differing from the other juices of the plant.

THESE vessels terminate in the NECTARIA at the base of the filaments : and those NECTARIA are composed of vessels closed at their ends ; in which this tough juice is perfected.

THESE vessels, we have seen, communicate with those of the FILAMENTS : therefore the tough juice they contain is delivered into the vessels of the FILAMENTS , and is so carried up to the ANTHERÆ.

THE membrane or bladder, containing the rudiment of the plant, is much too large for that minute original : this is designed by nature to give room to a peculiar substance intended to be spread about it for its protection, and defence.

THIS peculiar substance is the tough juice, secreted in the NECTARIA or extremities of the single course of vessels : and this being delivered from them into the vessels of the filament, is carried up thro' them to the ANTHERÆ and de-

delivered into the globule of farina, at that part where it adheres to the inner coat of the tube.

THIS tough juice is true fluid wax. It is well known that bees collect their wax from the Antheræ of flowers ; and this is the original substance. They feed upon the globules of farina ; the vegetable rudiment serves them as nourishment ; and this tough substance is discharged again at their mouths, and being thus separated from the minute plant and its juices, it is true wax.

No substance could be so proper for defence of the rudiment of the plant ; for this is tough and ductile, so that it will pass with it thro' the necessary channels ; and not separate from it : and it cannot be dissolved, and wash'd off from it ; because wax is indissoluble in water.

THUS is the new plant produced from the extreme part of the old : and thus it is enclosed and defended. But this membrane would soon shrivel ; and this pulp of waxy matter decay ; and the young plant

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would

would be incapable of preservation, till the industry of man, or accidents of nature, committed it to the ground. It is, therefore, lodged afterwards in the seed ; and there defended sufficiently.

BEFORE we advance to this last consideration, it may not be improper to observe, that this construction of the farina, tho' different from what former authors have described, does not contradict the truth of their representations.

THEY say the globule of farina bursts, and discharges a quantity of atoms : the waxy substance, not mixing with the juices of the plant, which are watery, always appears composed of minute and separate particles, even in the body of the globule ; and when it is discharged into the water, in which the farina is laid before the microscope, it appears still more disunited. These little particles were, perhaps, what they have called atoms ; and they did not observe the rudiment within.

C H A P. VI.

OF THE COURSE, USE, AND TERMINATION OF THE PITH.

THE Pith is the innermost substance of a plant, of whatsoever nature or construction that be.

IN the fibres of the root of this *Amaryllis*, it forms the central part, and it is like the other portions of the root, continued up into the stalk : but this stalk being hollow, it only forms the inner lining of it. 'Tis placed under or within the fleshy substance which terminates in the filaments ; and it forms the style and the inner coat of the seed-vessel ; which is, indeed, a continuation only of the same substance.

THE four other coats of the plant being laid open, or by a careful maceration removed, this central matter appears : and we may pursue its course easily thro' the plant,

from the extreme fibres of the root, to the stigma or head of the style.

THE others, by degrees, leave it; terminating in the several parts we have named: and its final course, under covert of any them, is in the rudiment of the seed-vessel.

HAVING made the inner coat of this, it contracts itself into a kind of neck in the top of that rudiment: and this being continued in length, forms the style; which accompanies the filaments a little way, but then droops under them, and exceeding them in length, terminates in a stigma or head, divided into three rounded parts.

C H A P. VII.

THE CONSTRUCTION OF THE STYLE OF
THIS AMARYLLIS.

THE central substance in this plant is every where loose and spongy ; composed of large vessels, and abounding with a watery juice.

THE structure is the same in the style : this is loose, spongy, tender, and watery ; and is only covered with a thin membrane.

It has been thought essential to the fecundation of the seeds in plants, that the style should be hollow : many have been perplexed at not finding it so ; and some, to the scandal of philosophy, have figured hollow styles, where they did not find them, to favour their systems.

IN this plant the structure is easily traced, and it is highly elegant. The style has not an absolute cavity, but the purpose of such a one is plainly answered ; and we see how.

THE stigma or head of the style, which is the extreme part or termination of the pith of the plant, viewed with a microscope, appears composed of three rounded parts, resembling irregular segments of spheres : and the whole surface of these is covered with prominent tubercles white as snow. See Pl. V. fig. 1.

THE general colour of the style is crimson ; and such is the outer part of each of these divisions of the head ; but in the midst of each is a white spongy substance.

THE prominent particles on the verge of each division of the stigma are closed at their ends, and even thickened in a clavated manner : but those which rise from the white central part of each division are open : they
are



The Stigma of the Amaryllis.
1770 del. et sculp.

are the mouths of so many tubes, and they are larger than the others.

THE open mouths of these are wide enough to admit, with ease, one of the minute rudiments lodged in each grain of the farina; with its pulp of waxy matter about it.

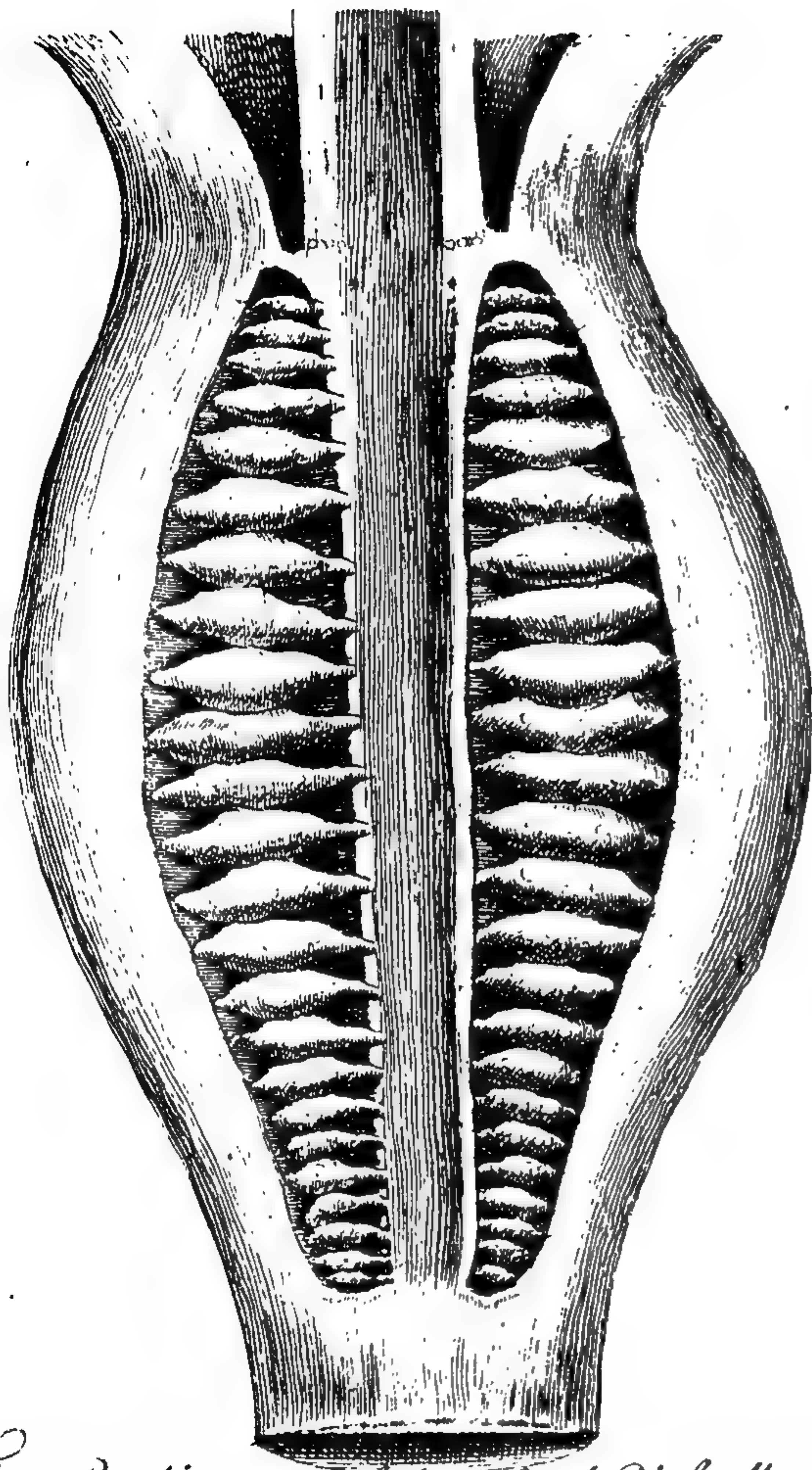
THE three general passages from the separate portions of the stigma, unite at a small distance below that part, and from one common passage of the same kind; which may be distinguished in a transverse section of any part of the style. See Pl.V. fig. 2. And when that organ is opened longitudinally, with due care, this passage shews itself in its single state along the style, with its division into three branches for the three parts of the stigma. In the lower part, it does not terminate with the rest of the style, but is continued in form of a column, thro' the centre of the feed-vessel, every where united to the rudiments of the seeds.

THIS central part of the style is form'd of the largest vessels of the pith of the plant, with some few air tubes intermixed, and a very small number of hard fibres.

As the vascular part of the fleshy substance of the plant swelled out into vessels or membranaceous bladders in the antheræ; in the same manner the vascular part of this pith, where it runs like a column down the centre of the seed-vessel, swells out on every side into the same kind of bladders: and these are the shells of seeds. Pl. VI.

ALL this may be distinctly seen in the new form'd rudiment; and the only difference between these shells of the seeds and the membranes of the farina is, that they are more firm, and have about them somewhat of a spongy substance.

C H A P.



The Rudiment of the Seed Vessel. THU. del et Sculp.

C H A P VIII.

THE MANNER OF IMPREGNATION.

THIS is the structure and conformation of the AMARYLLIS here described: and thus the method of impregnation is easily seen. Like all the other operations of nature, being truly understood, it is found much more plain and simple than men of contemplation had imagined.

THE fleshy substance of the root and stalk is the essential part of the plant: its growth is the growth of the plant; and nature has for this reason lodged it under three coverings from the outer air, and under the defence of a fourth within the hollow stalk.

THIS part, in the common growth and encrease of plants, continues, and protrudes itself downwards in the fibres of roots, and upwards in stalks and branches: this pushes
out

out small rudiments of the entire plant in form of buds along the branches; and this terminates in the same kind of rudiments, tho' extremely minute, in the ANTHERÆ on the heads of the FILAMENTS: these parts being the final terminations of its growth.

THE rudiments, which this fleshy substance sends out in form of buds on the branches, are defended by many films; and these, which terminate its growth in the Antheræ, have their membranaceous covering also; and within it a pulpy matter, indissoluble, as we have shewn, in water, yet easily ductile.

THESE are too tender to be trusted to the air; and the course of nature being irregular in their falling to the ground, as winds and seasons vary; this is the method of their preservation.

WHEN the flower is newly opened, the Antheræ are long and white, therefore they are entire; and the stigma is small, flattish, and dry.

WHEN

WHEN the Antheræ burst, the stigma swells ; its three divisions become more prominent ; and the white particles rise higher above their surface.

THE Antheræ contract and harden soon after they are opened ; and by this means the grains of farina are rendered loose upon them ; and the least motion of the air shakes them off. Multitudes are scatter'd and lost ; but a great many fall upon the stigma : and whatever falls there, is detained by its rough and frosted surface.

THE top of the stigma is always moist ; and we see under the microscope the effect of water on the grains of farina : they burst in it ; and discharge their contents.

IT is the same when they fall upon the stigma, loaded as it constantly is at that time, with moisture. They burst ; and there thus issues out of each grain of farina a minute plant,
fur-

surrounded every way with a tough, ductile, and indissoluble substance.

THE mouth of a tube is open to receive this ; and the course of the tube is with an equal diameter through a spongy part in the centre of the style.

THE inside of the tube is moist ; and the minute rudiment thus received into it is forced along by the same power by which leaves and all other parts of plants imbibe dews, and transmit the moisture inwards.

THE minute plant thus carried thro' the length of the style, and into that part of it which runs like a column down the centre of the seed-vessel, can be forced no farther, for there is no more passage : this spongy column has no communication but with the style itself. We have seen that on each side its vascular part has formed a kind of shells or bladders: the passages into these are open ;
and

and the minute rudiment is naturally forced into one or other of them.

IN this manner, the first grains of farina, which fall on the style, deliver their rudiments of plants to the tubes ; and all the shells of the seeds are, in succession, occupied.

As soon as this is done, the style having performed its office, fades : and all that appears to receive any nourishment from the root, is the feed-vessel. The shells of the seeds become thickened ; and a farinaceous substance, formed of the drying juices of the vascular part of the pith, surrounds the minute plant in that covering : thus is the seed compleated, and vegetation in the plant then stops entirely.

EACH thus seed contains a minute plant, so well defended, that it can bear, like that in a bulbous root taken out of the earth, the common injuries of the seasons : and when committed to ground at a time when there
is

is due heat and moisture, it grows as the rudiment in the root ; and in the same course forms its own seeds again.

THIS, by the present example, appears to be the course of nature in the production of plants : and if it shall be confirmed in others, we shall have no need any more to have recourse to elastick atoms, or impregnating air : what is called the production of new plants will be found nothing more than the continued growth of the old : the rudiment in the seed being only a piece of the fleshy substance of the stalk delivered into that part from the globule of farina ; and with the requisite heat and moisture continuing to grow.

F I N I S.

B G L

3

A
M E T H O D
OF PRODUCING
DOUBLE FLOWERS

F R O M
S I N G L E,
BY A
Regular Course of CULTURE.

Illustrated with FIGURES.

The SECOND EDITION.

L O N D O N :

Printed for R. BALDWIN in Paternoster-row.
MDCCCLIX.



DEDICATION.

To the Celebrated

Dr. HALLER.

S I R,

IT is not that I suppose my weak voice can return the honour you have been pleased to do me, by the mention you have made, in your immortal works, of some of my attempts towards the advancement of botanical knowledge : that were a thought as vain, as it were idle : but where returns are impossible, there may yet be gratitude. I address my acknowledgements to you in this slight Treatise :

A 2

wherein,

DEDICATION.

wherein, whatever may be wanting, there yet is TRUTH: and some of it has not been known before.

THE World will pay a due regard to these doctrines, when they see I dare address them to your experienced and discerning eye: and I have some pride in dedicating the research to the eternal memory of those new lights which your genius and indefatigable labours have thrown, not on this science only, but on all philosophy.

I am,

With the most perfect Respect,

S I R,

Your obedient

and humble Servant.

*London,
Jan. 4, 1759.*

J. HILL.





THE
P R O D U C T I O N
O F
D O U B L E F L O W E R S.

THE raising double flowers is one of the great articles in the gardener's and florist's professions. 'Tis often done: but none knows how. The practice by which these elegant plants are obtained from the single, is little different from that by which, in other kinds, single rise from single in succession; and the procedure is merely mechanical: the gardener practises in his age, what he saw done in his youth; and he expects the same success, without farther thought.

IT

It would be happy if the change thus produced in a few plants could be extended to many : and perhaps this is not beyond the human reach. To attain the end, it must be attempted regularly ; and in order to that, the subject must be first understood.

WE must know by what means and in what manner nature gives this doubleness to flowers, in the instances already seen, before we can attempt rationally to assist in her operations upon others : but when that is discovered, the just grounds of such an undertaking will be known.

THE stalk of every plant is composed (as has been clearly shewn) of six distinct substances ; surrounding one another in a regular manner : these are the outer bark, the inner rind, the blea, a vascular series, the fleshy substance, and the pith. The roots are composed of these ; they are continued thence up the stalk ; and from one or other of them are formed the several parts of flowers.

THESE

THERE is no way to understand what the doubleness of a flower is, or of what it consists, until this structure of the whole plant be understood.

As all the parts of a flower are continuations of one or other of these substances, all doubleness in flowers must be owing to the luxuriance of some of them : nothing new is produced, nor can be ; only some original part is extended.

THE first step towards understanding the process of nature, is to examine which of the proper parts of a flower has afforded the luxuriant growth : We are then to see to what original portion of the plant, that is to which of the six substances whereof the whole consists, that part belongs : when we know this, we are to enquire by experiments, what nourishment, and what method of culture most favour the growth of that part : and, if we find this, we shall discover the great secret.

WE shall thus know how at our pleasure to double the flowers of many plants ;
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and

and to produce that luxuriance in degree as well as kind.

IN this course it is proposed to pursue the subject in the present enquiry : determining the first attempt to a single plant. There is no other way to avoid perplexity ; and if we succeed in this, it will be easy to continue the same reasoning, and the same practice to others.

IT will be most useful to select a plant, in which the parts are large and plain ; and one, of which we can be sure, during the successive years of trial. I shall for these reasons chuse a TULIP. The organs in this flower are all large, the doubleness is not too complex, and the root being yearly taken up, we can always be sure of having the same plant.

THE Tulip is not selected as an instance for its beauty ; for it is less improved by doubleness than many other flowers : but because the parts being few, large and distinct, the course of nature may be traced in it easily.

GAR-

Pl. O.



THE IRREGULAR FULL TULIP.

L. Hill delin. et sculp.

GARDENERS despise double Tulips; and if no better could be produced by art than such as offer themselves to them by accident, they wou'd have reason. They see the CLERIMONT with a ragged multiplicity of ill shaped petals; or the common breeder reduced to a dwarf and edg'd with white, with a wild cluster of like petals, and the filaments irregularly disposed among them; or with half formed petals growing from the edge of some of the filaments, and buttons upon the irregular extremities of others. This is all they see of doubleness in Tulips; and this rises wildly. See PLATE(o)

BUT if doubleness in a Tulip can be produced in a regular manner, the new leaves rendered as well shap'd as the old, and the same excellence of colour preserved in these, as in the single, doubtless the florist will receive it into his list of beauties. That this may be done appears very probable; and the instances here produced shew there will be great beauty in the flowers: not only in their perfect state of doubleness, but in the several advances towards it. The attempting this regularly, is a work of time, because the

Tulip is a slow grower from seed ; but by the flowers here produced there is reason to believe it will succeed : and the benefit will not end there. Nature proceeds nearly alike in her several operations, and what prospers in one plant probably will not fail in another.

THE origin of the Tulip flower is this. The fleshy substance of the stalk terminating in the antheræ, there forms a minute plant, or rudiment of a plant in each grain of the farina : this is received into the stigma ; and thence conveyed by a short course to the seed vessel ; where it is lodg'd in the yet empty hull of a seed * : it is there cloathed with a farinaceous substance, secreted for that use in those vessels ; and, the seed hardening, it is perfect.

THIS seed being sown, the rudiment of the plant expands by means of the heat and moisture ; and its several parts growing, downwards into fibres, and upwards into a stalk and leaves, the Tulip is produced, which in its perfect state we are now to examine. See plate 1.

As

* This is explained at large in *Outlines of vegetable generation*.



COMMON TULIP.

Hull delin et sculp.

As the rudiment in the farina is very tender, it takes a long time in expanding all its minute parts, and growing to perfection : and to defend the more delicate organs of the flower the bulb is formed. This is not the root, tho' it be vulgarly so called, but is a germ or bud, surrounded by a number of coats, and films like those which cover the young leaves in buds of trees.

THESE films are produced or thrown off from the outer bark of the fibres ; which are the real proper and only roots : and from the innermost of these films proceed the leaves.

THE regular continuation of the four other substances is in the stalk and flowers : and it is performed by nature in this manner.

THE outer bark which is thin and delicate, is defended and kept moist towards the base of the plant by the lower ends of the leaves, which surround the stalk : but higher up, where it is naked, it becomes harder and somewhat thicker.

It runs up to the summit of the stalk, and there forming three thick knots or clusters, is continued through them into the three outer petals of the flower. These are formed entirely of it, and in these its whole substance terminates.

In plants which have a cup under the flower, the outer bark of the stalk forms that cup, and terminates in it : the second, or inner rind forming the petals, by a continuation into the flower.

It has not been enough regarded ; but nature where she gives no cup to the flower, always allows something analogous. The Tulip consists of six petals : of these the three outer are harder than the three inner, and serve as a defence to them. They are a kind of cup to the three delicate ones within.

THE outer bark of the stalk constitutes these three petals entirely ; and it is there lost. When the flower is newly opened, it has the property of the leaves of sleeping plants ; shutting itself together in the dark,

dark, whether it be night or an artificial gloom ; and opening again in the light.

THE cluster of fibres at the base of each outer petal perform this : They are the hinges on which the motion is made ; and the delicate inner petals are forced together by them. The fibres which form these clusters are white ; and are as strong as raw silk.

VARIOUS accidents influence the increase or diminution of particular parts in the composition of plants, but with this outer bark we have nothing to do in the present research : The doubleness of the Tulip is what we enquire into, and that arises only from the fleshy substance of the stalk. The outer bark terminating in the three exterior petals, we are now clear of it.

IN dissecting the Tulip stalk transversely and along, the next substance seen under this is the *inner rind*. This is greenish, but tending to white in the inner surface : It continues its uninterrupted course to the flower, and there forms the three inner petals.

petals. These have their origin plainly from this interior rind; and the fibres may be traced down from their bases to the stalk; with great ease.

THIS coat of the plant terminates plainly and solely in these; and consisting of simple and not numerous parts, it is incapable of any increase, or division, in the flower.

THE course of examination should be to remove the several parts thus separated, as soon as we have thoroughly examined them: therefore the two rinds of the plant and the two series of petals being now cleared away, there appears as the outer substance the *vascular course*, or third portion of the substance of the plant. This is extremely delicate and small in the Tulip. In a transverse section of the stalk it appears only as a line separating the greenish inner rind from the white fleshy substance of the stem; and in a longitudinal section it resembles a mere membrane.

THE microscope shews that it consists only of a single row of vessels: it terminates

minates just within the bases of the inner petals ; and there forms an irregular line nearly hexagonal, with small risings between the bases of the petals.

In many plants this part rises up conspicuously in the flower ; forming what is called a nectarium. The large nectaria in the Hellebore are formed of it ; and that tufted substance in the Amaryllis, examined in a preceding work *. Whether the termination of this part rises above the surface of the flower, or lies within its compass, and hid under the skin of the bases of the petals, its structure at the termination is the same. The vessels swell and are clos'd at their extremities ; and they communicate with no part but the bases of the filaments. This is plainly and evidently the case in the present instance ; and therefore probably in all plants this vascular course serves the same purpose ; secreting a waxey humour, and giving it to the vessels of the filaments, for defending the embryo plants in the farina.

ALL these parts being cleared away we come to the fourth in order, which is the
fleshy

* Outlines of vegetable generation.

fleshy Substance of the stalk: This we may trace with ease up to the filaments themselves, which are formed absolutely and solely of it: and from observing its structure we shall find the reason why Tulips are doubled, in the manner to be represented in the succeeding plates, more easily than many other flowers.

DOUBLENESS in various flowers rises from a luxuriance of different parts: In Columbines from what are called the nectaria; which are either simply increased in number, or converted as it were into petals; and in the Narcissus kind, sometimes by an increase and division of the nectarium, the petals remaining as they are naturally, six in number; and sometimes by an absolute increase in the number of the petals: But in the Tulip it is altogether otherwise; the doubleness of this flower arises from the filaments and no other part; and is accomplished in the succeeding gradations.

WE see by the dissection of the plant, that the filaments are formed of the fleshy substance of the stalk, or more properly

perly speaking, they are the termination of that part. During its course up the stalk it has been defended by the surrounding substances ; but in the filaments which are exposed to the air the membranes investing it become more firm, and its substance more compact : that is all the difference.

THIS fleshy substance is remarkably thick in the stalk of the Tulip. Its quantity is greater than in any other plant I have examined : and hence arises the natural tendency of the Tulip to doubleness ; from a luxuriance of the filaments.

THESE are in the state of nature very thick in this flower, and of a peculiar shape and constitution : they are flatted, tho' irregularly, and are edged and triangulated ; and they are usually coloured. In all this they resemble petals more than the filaments of the generality of flowers ; which are usually rounded and solid.

THESE in the Tulip shew a very peculiar construction when cut open, and

examined by the microscope. They are found to consist of two parts, a solid central yellowish matter, and a coat or shell of a filmy substance surrounding it. This is loosely and easily separated from it.

THE thickness of the filaments arises from that of the fleshy substance of the stalk, whereof they are so many continuations: and it renders them liable to alter their form by farther swelling, if an increase of that part favours such change: their peculiar structure also makes it easy for them to spread into a resemblance of petals, the membranes covering them being much of that nature.

Thus the doubleness of the Tulip is produced only by a luxuriant growth of its filaments; which in that state lose their proper nature, and become a kind of petals. This flower is most liable to such doubleness, because the fleshy part of the stalk is thick; and plainly the doubleness is owing to an increase in the quantity of that part. The practical lesson follows hence plainly. Certain circumstances in the culture and management of plants
favour

favour the increase of particular parts in their construction : the way therefore to produce double Tulips, and to increase the degree of their doubleness, is to discover what circumstance, what soil, manner or management it is that thickens this fleshy part in some degree : and to apply it early, and pursue it thoroughly. What may be done in this case we shall shew by declaring what has been.

As we have on this occasion named the four exterior coats of the Tulip-stalk, it may be proper to say what becomes of the pith, or innermost substance. This is continued to the rudiment of the seed-vessel, and terminates in it. That rudiment with its stigma, for there is no style, are formed of it entirely.

C H A P. II.

Of the Progress of the Doubleness in the TULIP.

THE TULIP in its natural state, consists of six petals, six filaments, and a rudiment of a seed vessel, crowned with a stigma, divided into three parts. See *fig. 1.*

THE three principal organs of flowers are seen in it very distinct and plain, with no additional part, (as in the case of those that have conspicuous nectaria) nor any interruption, as in double flowers.

WHEN the Tulip alters from this plain and natural state, becoming double, the course and progress of nature may be trac'd in it, in five stages; and these naturally arise in succession one after another; the doubleness increasing each year from the first.

BUT this, though natural, and usual, is not an invariable course: sometimes a Tulip from being single, bursts at once into full doubleness; sometimes on the contrary when the change has been regularly begun, it comes to a stand in the succeeding year: and any double Tulip being left neglected in the ground, will again become single.

WHEN a large quantity of the seeds of well chosen single Tulips are sown, and the plants are raised by proper care to flowering, there will sometimes appear among
the

the number a few double ones the first year of bloom : but this is rare ; and they are never perfect.

The full change is too great to be expected at once ; for it is an old and true maxim, that nature does nothing by leaps, but all in a regular gradation.

AMONG the number of Tulips thus raised, the greater part will be plain and natural ; but a nice and well instructed eye will see in some few, the first approach to doubleness. These are to be selected ; and they are thus known.

IN the natural state, the filaments are raised in three blunt ridges, and are thick in proportion to their breadth. In some, these filaments will have lost the outer ridge, or that at the back ; and the whole filament will be broader, thinner, and flatter than usual ; and will begin to shew a different colour, tending to that of the petals. The antheræ also are in this case shorter.

THIS is the first approach which nature makes to doubleness. This the florist is
to

to mark ; and the plants in which it appears are to have peculiar care in the following years.

THE several gradations from this to perfect doubleness, are to be expected in the five succeeding seasons.

THOUGH the first approach towards this state in the Tulip be slight, and not distinguished, except by the inquisitive eye ; the second is considerable, and sufficiently plain. In this the filaments are so altered, that if they did not still support their antheræ, they would not by the common eye be known for such, or called by that name : they are indeed converted into a kind of petals. They are thin like the natural petals ; and a quarter of an inch in breadth : their colour also as well as substance is that of the petals. They rise with a single body, but at half their length they split. In the cleft of this division is seated the anthera : and the two parts of the divided filament are continued upwards in a moderate breadth, and in a waved form. *See Pl. 2.*

THE

THE anthera in this state of the flower is shorter, and less than naturally : but it still ripens a perfect farina. The seeds of such a Tulip separate from all others will be perfect ; and being sown, will succeed very well. I name this particularly, because they are the fittest of all Tulips from which to save seed for double flowers.

THOUGH the filaments in this state of doubleness have changed their form and colour, their construction remains the same as at first : each is composed of two membranes and a pulpy central substance ; but this last part is smaller in proportion than in the natural Tulip. This seems to be the matter which immediately feeds the anthera ; and therefore the farina, though less in quantity, yet is in this state perfect.

THE third degree of doubleness in the Tulip extends the filament in breadth yet farther, and starves the anthera entirely : therefore the flower is in this state incapable of ripening seeds.

THE Tulip now consists of twelve real petals : he who has trac'd the origin and observed

served the course of the production, knows that the six inner ones are formed from filaments; but to another they would appear almost perfect as the rest; only shorter and nip'd at the top. Though they have been form'd from filaments, they are now truly petals. We learn by this that nature tho' she regularly forms each part of the flower from a peculiar coat of the plant, in her usual course; yet can make the expansion of another portion answer the same purpose.

IN this state of doubleness the original petals of the Tulip stand in two series, in their natural order, three external and three interior; the six additional petals form one series rising within both: one in the center of each perfect petal, as the filaments rose in their natural state. *See Pl. 3.*

EACH of these additional petals, for in this condition of the flower they are absolutely such, is nearly of the breadth of the original ones, but not exactly of the same form. There is now no deep splitting or division into two parts at the top, as in the former condition of doubleness, where the anthera held its place in the center of the cleft; but the summit of the petals
is



THE FORKED TULIP.

L. H. del. et sculp.

M.S.



THE DOUBLE TULIP .

A. Hill delin. et Sculp.

is variously wav'd, and all that remains of the appearance of an anthera, is a point of a purple colour in the middle hollow of each of these petals; formed of what would have been the outer coat of the anthera. And even this is sometimes obliterated.

THE form of these additional petals is oblong, with sufficient breadth to give a regular appearance in the flower. Their upper edge terminates variously; sometimes they are pointed, usually very obtuse; in some flowers wav'd, and in others cut into deep incisions.

THEIR substance and construction still continue what they were in the filament; and differ, tho' not greatly now, from those of the other petals. Each is composed of two membranes, separated by a pulpy matter. This is the double Tulip.

THE fourth gradation, or second doubleness in the Tulip, renders it so unlike its first, or natural state, and so nearly obliterates all appearance of the parts from which the new petals have been formed, that none, unless in this course of enquiry could say whence it had proceeded.

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IN this state, or the TRIPLE TULIP, there are four series of petals: the two outermost are natural, they consist each of three petals, and are what properly constitute the flower. The two other series consist of six petals each, and these are formed by a luxuriance of the filaments, and an obliteration of the anthera, as in the former instances: with the additional peculiarity of their being split. This constitutes them twelve in number, and as the inner six are formed of the anterior sides of the filaments; they stand naturally forwarder than the others: this distinguishes the twelve into two series. *See Pl. 4.*

To understand the construction of this flower perfectly, one must go back to the natural state of the filaments; from an expansion and luxuriance of which, all this doubleness is still formed.

WE have seen in the original state, they are composed of a solid central part, surrounded by a membranous covering. In the first state towards doubleness in the Tulip, the filament extends in breadth, and this inner substance loses something of its thickness; in the second stage where
the



THE TRIPLE TULIP.

J. Hill delin et Sculp

the anthera stands in the cleft of the extended filament, this inner substance is still more reduced ; in the third stage, where the anthera is a thin line, this substance is only a kind of membrane uniting the two sides of the new petal ; and fourthly, in this state of tripleness it is a mere dot. 'Tis the expansion of the membranous coat of the filaments which makes the new petals : and the inner substance has no use in this change. It before supplied the anthera : that was its purpose ; and while the anthera remained in the second change, this substance remained also, though in less than the original quantity. In the succeeding state, tho' it remained in some small degree, its use and office were lost ; and in this triple condition of the flower being wholly gone, the two parts of the expanded filament, have nothing to unite or hold them together.

THIS third substance is naturally placed between them, therefore they are not joined to one another by any fibres or vessels of their own, except at the base ; and the third substance which kept them together in the last mentioned degree, being now

gone, they separate. Each side of the expanded filament becomes a new petal; and thus twelve are added to the flower.

IN a succeeding year each filament splits into three instead of two broad petals, and thus forms the **QUADRUPLE TULIP**; See *Pl. 5*: and one year more makes the **PERFECT FULL TULIP**. In the quadruple kind there remains a small mark of the anthera on each new petal, but in the perfect double flower there is none. See *Pl. 6*.

C H A P. III.

Of Doubleness in the VERONICA.

SUCH is the course and state of doubleness in the Tulip: and by this progression it will be perfectly understood. So large a flower was selected for the illustration of the system, because the gradations in those obvious parts are easily seen; and being known in this they may be understood also in many which are smaller. It has been observed there are other kinds of doubleness arising from other parts; but with that species of the change which proceeds from the filaments, the course of nature is the same in all.

THE



THE QUADRUPLE TULIP.

Hill delin et Sculp.

Pl. 6.



THE PERFECT FULL TULIP. *J. Hill delin et Sculp*

THE common tall *Veronica*, or Speedwell of our gardens, has a flower as small as any that is cultivated for ornament: but the great number of them, and their regular disposition in the spikes, gives them some claim to regard; and the celestial blue, which is their proper colour, more.

I DON'T know that it had been observed, till I remarked it in *Eden*, that the flowers of this plant sometimes have a kind of doubleness. 'Tis a very essential article in their beauty: for it not only adds somewhat to their size, but continues the fine azure colour perfectly through their whole body.

THE flower of the *Veronica* is placed in a small green cup. It consists of one petal, tubular at the base, and cut into four oval segments at the top. These are of a fine blue. Within these stand two filaments: they are naturally long, and towards the top have some breadth: they are of a whitish colour, and the antheræ which crown them are also white at first; but when they are burst, they are yellow.

THESE

THESE parts are plainly seen in so small a flower: and as the glow of universal blue in the spike is the true beauty of the plant, this partly coloured inside of the bloom greatly degrades the whole. In flowers too minute to be seen at any distance distinctly, the general good aspect of the cluster is what we are to attempt.

THIS, when the colour is all blue, gives as it were the appearance of one pyramidal flower to the whole spike. It cannot be thus in the natural condition of the plant; but accidents we do not understand make it so sometimes in gardens: nor does the common eye even while it admires the effect, see the cause.

IN those plants of the Veronica which have spikes perfectly blue, the flowers are in a certain state of doubleness. It is the same degree in the gradation of the Tulip, in which the filaments are expanded into a kind of petals; and the antheræ are wholly obliterated.

THE change is less conspicuous because the flowers are in this plant so much smaller:

smaller : and it is indeed less in itself, because the flower has only two filaments to be the objects of the variation. The advantage however is very considerable this way : for the filaments grow near as broad as the petals, and with this change of shape, they put off their proper colour. The irregularity they give to the general flower is not regarded ; partly because the whole is so small as to escape strict observation ; and partly for that the segments of the flower itself are irregular, the lowest being narrower than the others.

So much as we have now mentioned, culture sometimes does without being directed immediately to that end. There can be, so far as we yet know, but one degree of doubleness beyond what we thus find by accident ; and perhaps it is not impossible to obtain that by art. The extreme state of doubleness in flowers, which owe the increase to the filaments, is that each of them having been expanded, should divide or split itself into two. If this can be brought about in the Veronica, each flower will be rendered just double what it was before ; for the new
petals

petals produced from the filaments will equal the four original ones : the spike will thus under the same surface contain twice the quantity of flowery matter, and all will be uniform in colour.

THIS is to be attempted the same way as in the Tulip; for there is little difference between the constituent parts of that plant and this, except in their dimensions. These small filaments are composed of the same matter, and constructed in the same manner with those larger; and they arise from the same original part of the plant.

IN the Veronica, carefully dissected, we find the several coats of the plant continued from the root to the flower, as regularly and as perfectly as in the preceding instance. The outer bark of the stalk constitutes the cup, and terminates in it just as the outer bark of the Tulip does in the three exterior petals of that flower: The second rind forms the flower, and all its parts terminate solely there. The single course of vessels terminates in an irregular ring, just within the tubular base
of

of the flower; the fleshy substance runs up into the two filaments; and the pith ends in the rudiment of the seed vessel.

I HAVE traced several years the progress of nature towards doubleness in this flower, and have found it pass through all the stages of the larger kinds. Generally the increase has proceeded gradually, and regularly in plants, from the same root: but sometimes it has been interrupted, and the flowers have for two or three seasons kept only the same degree of doubleness; from which they have afterwards advanced farther, or else declined to their original weedy and pyebald state. Gardeners have observed that some years their Veronicas were finer, and some years worse; but they have not guessed the manner of the change; much less the cause.

THE irregularities in this progress of the plant towards perfection in doubleness, tho' very singular, I think may be easily explained according to the rules of culture; and if this can be perfectly done, the method of doubling flowers by art, will be then fully known. Of this I am certain

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from

from experience, that a neglected double plant will in three or four years, by degrees, become single. This shews the luxuriance of the parts is owing to nourishment; and we shall from experiments find certainly what part, or what article of culture it is which increases the fleshy substance of the stalk, whereon this change depends; and therefore by that be able to produce it: not casually or imperfectly as it happens now, but regularly, fully, and compleatly.

THE progress of doubleness in the *Veronica* flower proceeds thus in its three stages or gradations; for the fourth or perfect state, tho' I doubt not but the plant is capable of it, we have not yet seen. In the state of nature the filament is whitish, long, narrow at the base, and somewhat broader at the top, and it is crowned with an oblong anthera. In the first stage of the change, or rather in the approach towards the change, the filament becomes broader and more blue throughout. The anthera continues white, but is smaller than before, and the quantity of farina is much less.



1. Single & Double Veronica.

IN the second stage the filament becomes considerably broader, and more approaches to the colour of the rest of the flower: the anthera is become small, and runs along the edge of the broad top of the filament like a thin white line. In the first stage it contains some farina; and in due time it bursts: in this it has none, nor does it ever open.

IN the third stage the filament is yet broader: it approaches to the form and nature of the segments of the flower, and the anthera is quite obliterated and lost. This is the utmost state of doubleness yet known in the Veronica; and this is a great addition to its beauty. The rest is to be attempted: and we have beside the grounds of the process thus discovered in the structure of the plant, the absolute proof of contraries, at least in favour of the expectation. Experience shews that a neglect of culture will reduce double flowers to their original single state; and there is no reason to doubt but good management will as regularly make the single double. See *Pl. 7.* where 1. is the single, 2. the double plant; 3. the single flower separate, and 4. the double one.

C H A P. IV.

Of the Degradation of double FLOWERS.

NO one is ignorant that double flowers have been produced originally from the roots or seeds of single ones; by accidents favouring the peculiar growth of that part of the plant whereon the doubleness of the flower depends. This is plain from the course of nature in her productions. For the anthera being obliterated in the third and fourth degree of doubleness arising from the filaments, there can be no seeds ripened in the seed vessels of such flowers. We have seen elsewhere, by undeniable proofs, that the rudiment of the future plant is contained in the globule of farina; and that the seed is only a shell or case for its reception, preservation, and defence. Therefore when there is no anthera, no seed can ripen : and consequently perfect double flowers cannot be raised from the seeds of plants, with the same kind of flowers.

THIS shews that in botanical strictness, it is right to call the plants with double
flowers

flowers VARIETIES of the single, not distinct species from them; but they have stretched the point too far, who call them MONSTERS.

As a peculiar degree and kind of nourishment given to the roots in a particular manner, has swelled and expanded the fleshy substance of the stalk, and made it in these instances luxuriant in the filaments, the consequence of neglect will be a degradation of the flower, as regular as was the rise to this kind of excellence.

WHEN a Tulip has from favouring circumstances in the course of four, or with interruptions in five, six, or more years, been passing the several stages to perfect doubleness, the filament first expanding simply, then dividing, the anthera being obliterated in the third stage, and the body of the filament split flatwise in the fourth; so in the same course of years, or perhaps fewer, with neglect, it will descend to its original simplicity again; unless the same good management which favoured the increase of the petals continue, and preserve it.

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IF a Tulip which has thus attained the state of perfect doubleness, be every year taken up at a certain period and planted in good compost afterwards, it will continue always such as it appeared when perfect. The bulb is renewed every year; and there is therefore no decay from age. But on the contrary, if the root be planted when thus perfect in common ground, and suffered to remain there, the soil being neither changed nor dug, tho' it be ever so well cleared of weeds, the consequence will be that tho' the plant retains all its vigour, the flower will yearly lose part of its doubleness. The first year the twelve additional petals will be reduced to six, and there will be in these a portion of that yellow substance which formed the body of the original filament: The second year the antheræ will appear upon the tops of the six additional petals; and those will be narrower and thicker, and less colour'd than before: the third year they will differ little from common filaments; and the fourth season will afford from the same root a common single Tulip.

IN the Veronica it is the same. Let a plant of it in the best state of doubleness

we know, be left in an undug border ; the second year shall shew the form of an imperfect anthera upon a pale and somewhat narrow inner petal. The third season the anthera will shew its proper form, and the filament will become narrow and be but little coloured ; and the fourth summer shall produce a common single flower. ☺

WHAT this neglect reduces to its original state, culture has plainly raised from that state into the other. That culture can do something towards the producing this change in the *Veronica*, must not be doubted, for this season the plant has risen to the third stage of doubleness with Mr. *Lee* of *HammerSmith*, to whom I recommended the care of it when named in *Eden* : and there is a beauty in the flower greatly superior to what has before been seen. The spike is shorter, but the flowers appear in a perfection altogether unknown before : they seem as if they were twice as thick set as usual, for each flower having a larger number of petals, appears nearly as big as two. The new petals naturally curl a little inwards ; and this has
an

an advantage : for the inner part of the flower is whitish, and would naturally give some of that motly aspect we dislike to the whole, but these new petals hide it by their curling, and the whole is a celestial blue.

THE attempt to effect these changes by a regular culture must be thus : the roots must be new planted every autumn, and MARLE added to the mould. We find this increases that part of the timber of trees, which forms the filaments in flowers. Every plant must have a yard square of ground, whereon nothing else grows ; and the stalks must be annually cut down as soon as they begin to flower ; watering the root daily for a month after. This fills the bud for the succeeding year with the fit nourishment.

T H E E N D.

DIRECTIONS to the B I N D E R.

Plate 0 to face page 9.—Pl. 1. p. 10.—Pl. 2. p. 22.—Pl. 3. p. 24.—Pl. 4. p. 26.—Pl. 5. p. 28.—Pl. 6. *ibid.*—Pl. 7. p. 34.

T H E
O R I G I N *and* P R O D U C T I O N
O F

Proliferous Flowers.

W I T H
The C U L T U R E at large
F O R
Raising D O U B L E from S I N G L E,
A N D
P R O L I F E R O U S from the D O U B L E.

Illustrated with F I G U R E S.

By J. H I L L, M. D.

L O N D O N :


Printed for the A U T H O R, and
Sold by R. B A L D W I N in *Pater-noster-Row*,
and J. J A C K S O N in *St. James's-street*.

M.DCC.LIX.

OF THE

OF

Proliferous Flowers.

 POLIFEROUS FLOWERS are those which have a second, arising with a new stalk from the centre of the first; and sometimes even a third from this second.

ALL prolificious flowers are accidental : There is no species which naturally and constantly appears in this form. They are variations from the ordinary state of nature, occasioned by the abundance of a peculiar nourishment ; and are generally the effect of culture.

Most flowers must be double before they grow luxuriant in a new offspring : but we have a singular instance of one where the flowers are proliferous to the third degree, and yet single.

THE Composite flowers sometimes produce a secondary offspring, but in a peculiar manner ; not in the plain way of proliferation : The new flowers arise, not from the centre, but round the sides. The CHICKEN DAISY, and the CHILD-
BING

ING MARYGOLD give familiar instances of this ; and the last summer has produced a new one in the Sea Chamœmile.

ACCIDENTS, unknown to the gardener, have hitherto afforded him proliferous flowers ; but perhaps 'tis in the power of art to produce them. The philosopher, by tracing the progress of nature slowly and steadily in this luxuriance, and the gardener, by observing carefully what accidents have preceded the appearance of such flowers when they have risen in his beds, may together lay down a regular course of culture for their production.

SOMETHING like this will be proposed, tho' but imperfectly, in the present treatise.

As the raising double flowers is in most cases an essential requisite to the possible production of the proliferous, the full detail of the gardeners management of both was reserved for this place : the general system only having been given in a preceding work *.

MANY plants have occasionally double flowers from nature or by culture ; but the species are very few in which we have yet seen proliferation. It seems therefore a difficult operation of nature. There will be the more glory in the success if art can
give

* Production of Double Flowers.

give assistance : and this, since the cause is plainly in luxuriance from nourishment, perhaps, under due care, it may.

WE have long been accustomed to the PROLIFEROUS RANUNCULUS, even to the third stage ; and occasionally ANEMONIES of the same form have appeared in the florist's borders. To these Scotland added a proliferous GEUM ; and Germany a ROSE, of the third order : The proliferous CARNATION followed these, and closed the catalogue ; till last year we received from Africa a proliferous PIONY, the product of wild nature.

THE increase of this kind in composite flowers is less specious, and less remarkable ; but even that is also very limited. Beside the Daisy and Marygold, we saw only one Hawkweed and a Scabious till the last year added the Chamœmile to that short list.

So very sparing is nature in this article ; and so little has art yet added to it. The figures of the several known kinds follow ; except the Piony, which is too vast to be represented to advantage in this small form, where all is of the size of nature. This I have given in another work *.

THE Ranunculus is the most frequent of the proliferous kind ; it will therefore

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be

* Exotic Botany.

be useful to consider that plant first : And as it naturally grows double before it becomes proliforous, we may advance most regularly by first tracing its changes to that state.

C H A P. II.

Of the RANUNCULUS or CROWFOOT.

IN the common CROWFOOT ; or single RANUNCULUS of our meadows, the flower is thus form'd. A cup of five leaves terminates the stalk ; and within this are placed five broad petals or flower leaves, with small bases, and a cell or hollow dent, open or cover'd near the bottom : This cell Linnæus has named the Nectarium. Above stand numerous filaments, and from amidst these rises an oval head, which is a receptacle of seeds, cover'd on the surface with rudiments of them. The single garden Ranunculus, tho' a native of Asia, differs little from this in the construction of the flower : and it is from that single Asiatic kind we are to trace the course and progress of the change, first to a double, and thence to a proliforous state.

In the single Asiatic Ranunculus there usually is a petal more than the proper number.

number. One of these flowers is represented, Pl. 1. Fig. 1. cut upon to shew its construction. It is frequently yellow in this state, but as it grows double it becomes tinged with scarlet ; and is at last scarlet entirely.

THIS change of colour is more extraordinary than the common variations of red or blue into white ; but it is not singular in the *Ranunculus*. The native and original tulip is yellow, yet red is common in our gardens ; and in the *Impatiens* we see the fair gradation.

THE stalk of the *Ranunculus*, as in other plants, is composed of two rinds, a Blea, a flesh, and Pith. The outer rind of the stalk terminates in the cup but the inner rind, the Blea, and the other parts continue their course higher. These swell into a greater thickness in the Place where the petals rise ; and thence the body which they form gradually diminishes a little upwards. So that upon the summit of the stalk is seen a swoln part of a pearlike shape, with the broad end downwards, Pl. 1. fig. 1. *a. b.*

This is hollow within, and it is truly the stalk of the plant continued intire in that form, except for the want of its outer rind.

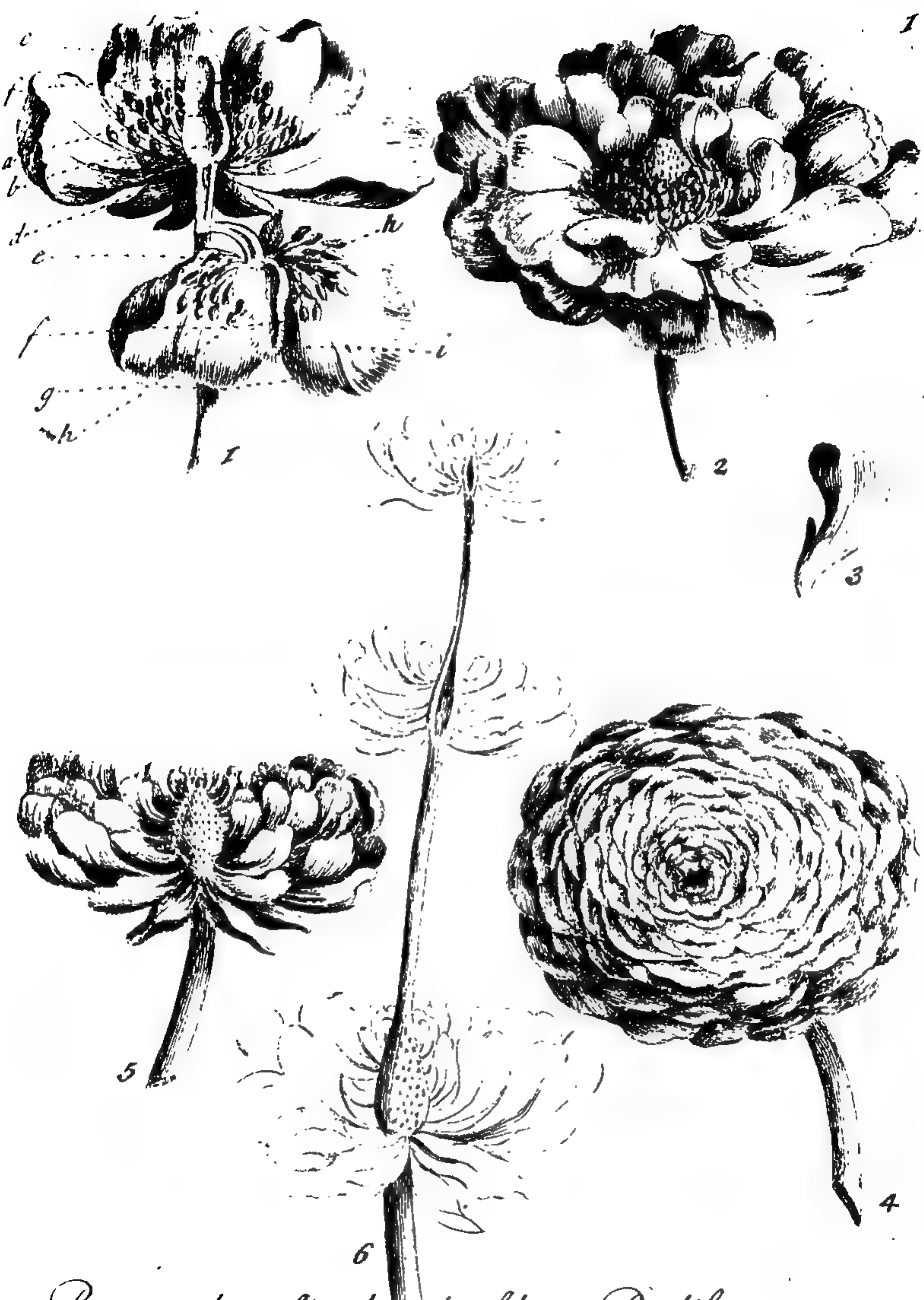
THIS pear-shap'd body is continued in a slenderer form upwards, hollow as the other ;

other; indeed making one continued hollow with it, and with the stalk; and at the top it terminates in a rounded and closed end *c*.

THE structure of this part is best seen by cutting in two a flower of a single, or nearly single *Ranunculus*; together with a piece of the stalk. Thus we may trace the mechanism of the head, and that will lead us to understand the manner wherein the flower becomes first double, and then proliferous.

THE stalk divested of its outer rind at the cup, is thus continued with its natural hollow up to the top of the receptacle or head of seeds; but the cavity is larger here than in the stalk itself.

THO' the whole head or receptacle with its two parts, the lower pyriform, and the upper cylindric, be a continuation only of the stalk of the plant, and indeed its natural termination; yet for the more clearly comprehending the structure of the flower, it will be useful to distinguish that part by different names in these its several stages. Thus what we call absolutely the STALK rises from the ground and terminates at and in the cup *d*. The pear-shap'd part we shall call the receptacle of the FLOWER *e*; and the cylindric, or uppermost portion of this, the RECEPTACLE



Ranunculus Single - double & Proliferous.

TABLE of the SEEDS *f*. By these names we shall distinguish the several portions easily and perfectly.

FROM the receptacle of the flower *e*, rise the petals *g*, and above these the filaments *h*. From the other part, or upper, arise the rudiments of seeds *i*, crowned each with its stigma, without a style. This is the natural state of the Ranunculus flower: the petals are only five or six; and the filaments are in a manner innumerable. These rise from the same receptacle with the petals themselves, and are of like structure: composed of the same parts, tho' different in form: the petals being broad and flat, these filaments rounded and slender; and each of them terminated by an oblong double anthera.

THE first change which culture produces in this plant is the rendering it double, Pl. 1. fig. 2. and 4. After this, if at all, rises the farther luxuriance, making it proliferous.

THE doubleness of the flower is produced by the filaments swelling in breadth, and thus becoming petals. This is performed exactly as in the Tulip: Instances of which have been given in all the stages in a preceding treatise. In the double Ranunculus we see the filaments diminish
in

in number as the petals encrease ; and the curious observer by looking over a bed of these plants when in flower, and examining the more and less double ones, will find, that the additional petals in those which are less double, are as yet irregular in shape. He will see the remains of the anthera in its proper place upon them ; tho' the body of the filament has swelled to twice its natural length and breadth behind it, forming a kind of petal. Pl. 1. fig. 3.

As the flowers grow more compleatly double these petals acquire more nearly the form of the others ; and the remains of the antheræ then disappear intirely.

Thus there are no filaments or antheræ in compleatly double flowers : but this is not all the change. While these parts have been gradually swelling into absolute petals, the receptacle of seeds has been by degrees diminishing : and when a flower is perfectly double, that part also totally disappears. Pl. 1. fig. 4. The receptacle of the flower having such an unnatural multiplicity of petals to support, the nourishment has all been detained there ; and as rudiments of seeds would be useless where they could not ripen for want of antheræ, nature has left no place of reception for them.

Thus

Thus is form'd the double *Ranunculus* from the single : abundant nourishment of a proper kind expanding the filaments into petals.

WE are next to enquire how proliferation, the utmost stage of luxuriance, is performed.

THE stalk of the plant which is continued thro' the head of the flower, Fig. 1. *b c g f*, terminates naturally in the obtuse top of the receptacle of seeds *c*. But this is not well seen unless the flower be cut open ; because the top as well as sides of this receptacle are in a state of nature surrounded with rudiments of seeds, whose purple and rough stigmata, cover the whole with a kind of down.

IN every double flower the receptacle of seeds is wanting ; and in these the extrem end of the stalk is seen in the top of the receptacle of the flower, where it either terminates in a multitude of very minute petals (Pl. 1. fig. 5.) or in a plain round end 4.

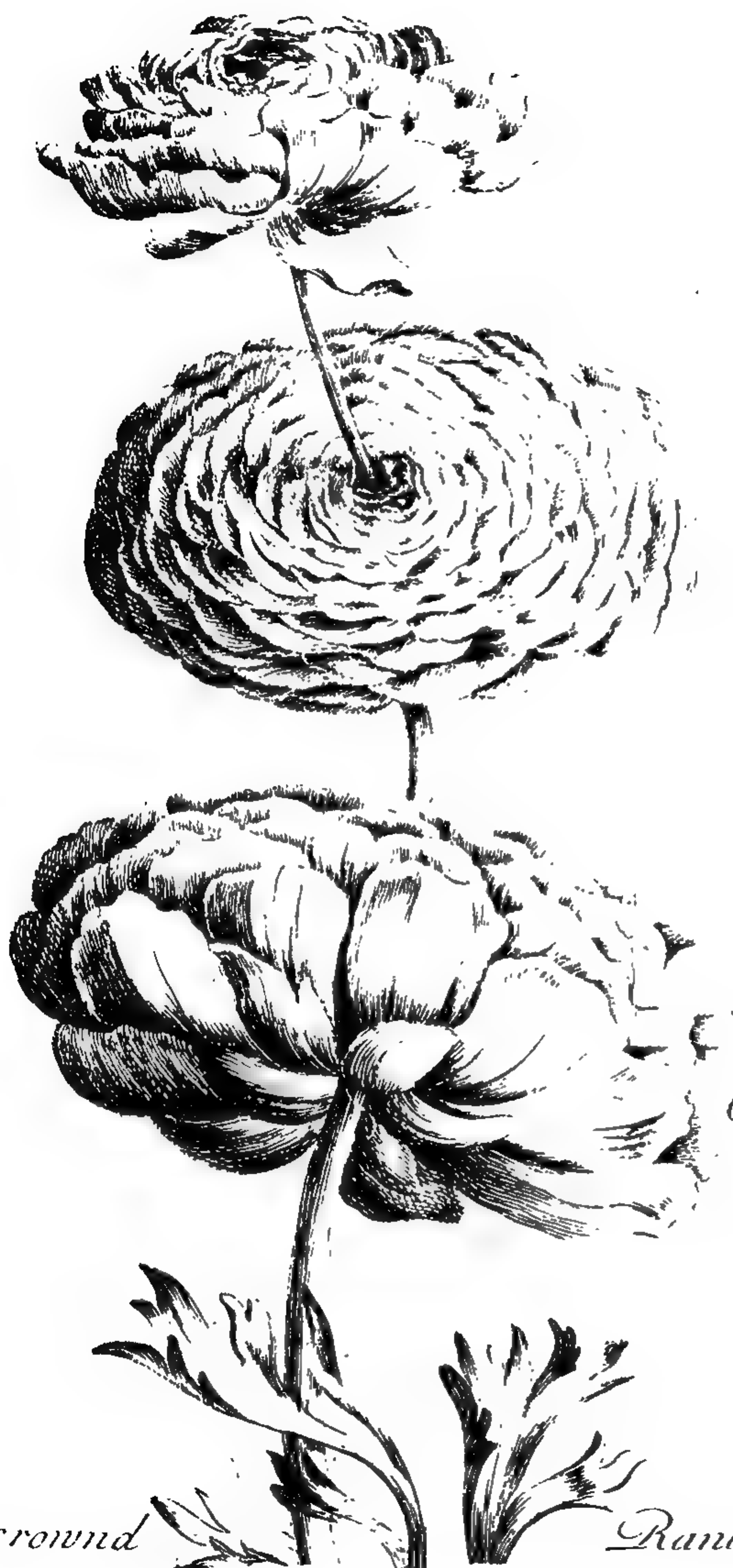
WHICH ever be the case, when the flower is cut open, the hollow of the stalk is seen to continue regularly up so far : and there it naturally finishes. But when extrem luxuriance pushes the growth yet farther, this is the seat and source of the encrease; and gives proliferation. The
C stalk

stalk instead of terminating thus in the center of the flower grows up out of it; rises to an inch or more in height; and bears upon its summit another flower perfectly like the first. Even from this second flower, in the highest stage of perfection, there rises in the same manner a third. Pl. 1. fig. 6.

THUS is the triple crown of the Ranunculus form'd; and 'tis a very elegant and pleasing effect of culture. Pl. 2. The second flower in this case has a cup; but it is less perfect than in the first: In the third there remains nothing of this part except a thickened and greenish back upon two or three of the lowest of the Petals. Each flower in such a plant consists only of petals fix'd to their proper head, without any receptacle of seeds.

IN all these flowers the additional petals formed of filaments may be distinguished from the natural fix at the bottom: for they have thick hollow bases; whereas those of the proper and original petals, tho' they be narrow, yet are thin, flat, and solid.

C H A P.



Triple crown

Ranunculus.

C H A P. III.

Of the ANEMONE.

THE ANEMONE has no cup. The leaf upon the stalk serves its office while the flower is in the bud ; and afterwards the three outer petals become so firm, and are so well fixed, that no more defence is needed.

EXCEPTING this want of a cup, the structure of the single Anemone is not very unlike that of the Ranunculus : but its doubleness is produced in a manner perfectly different.

THE flower of the single Anemone is composed of six petals, placed in two ranges : the exterior three are formed of the outer rind of the stalk, as is the cup of the ranunculus : the inner rind makes the three inner petals ; and the rest of the stalk is continued in a receptacle for the filaments and seeds.

THE receptacle of the filaments is oval, and that of the seeds is somewhat conic. This last takes its origin from the top of the former, and is one continued substance with it. The diminution of the receptacle of seeds from that of the flower, is less in this plant than in the ranunculus :

culus : so that the whole may be said to form one oblong oval body. The distinction of these parts is however essential ; tho' it be less strongly marked in this subject : and altho' it scarce appears externally, it is very obvious in the flower when cut open.

THE most proper kind of Anemone for this purpose is a single one, which has stood till the petals are ready to fall. 'Tis from this single state, we are to trace the doubleness, and proliferation ; and in a flower which has stood so long, the receptacles or head will be grown up sufficiently for that purpose.

TO the receptacle of the flower are fixed the three inner petals, and just above them rise an innumerable multitude of filaments, as in the *Ranunculus* : but they are as slender as hairs in this plant. Their antheræ are also doubled.

THESE cover entirely the receptacle of the flower, but they reach no farther. From the upper part of the head, which we call the receptacle of the seeds, rise the rudiments of those seeds : They stand close all over it ; and they are crowned with small styles, on which are blunt stigmata. This is the structure of the single Anemone.

IN

IN the *Ranunculus* we see the filaments become petals, in order to form the doubleness ; and the receptacle of seeds is then obliterated : but in the *Anemone* the filaments are too slender for this office. The additional petals in this plant are formed from the coats of the young seeds.

THIS is the course of nature : and for this reason we see three parts in a double *Anemone*, tho' but two in the double *Ranunculus*. In that flower, exclusive of the cup, there are only the natural outer petals, and the inner ones which have been formed of filaments : but in the *Anemone* there are first the two ranges of outer petals ; secondly the several series of filaments, which are a little alter'd in form and colour, but are not converted into petals ; and thirdly the additional petals, which make the doubleness, and which are formed out of the rudiments of the seeds.

THE filaments are altogether distinct from these. They are shorter and narrower : and they retain, in some degree, even the form of their antheræ, tho' the use of those parts be lost.

THUS is the double *Anemone* form'd : And the proliferous rises in the same manner from it, as from the *Ranunculus*. The
termi-

termination of the stalk in the double Anemone is in the summit of the receptacle, which in those flowers never runs up into any considerable length ; and it there naturally finishes in a cluster of very minute, and imperfect petals ; somewhat open, or else compact as a button ; formed of those rudiments of seeds which covered it.

WHEN the extream luxuriance of culture forces a farther growth after all the rudiments of seeds are converted into petals, this part is again the scene of it. The extream end of the stalk grows up, rises out of the flower, and ascending two inches above it, bears upon its head another flower, perfectly like the first. Pl. 3.

THIS is the origin of the proliferous flowers in the Ranunculus and the Anemone : It contradicts the modern philosophy, which says *proliferation is from the PISTILL*. For if it were so, there must be as many new flowers in the proliferous Anemone, and Ranunculus, as there are rudiments of seeds.

PROLIFERATION is indeed in these flowers a very simple proceeding. It is not the changing of one part into another, but the mere continuing of the stalk to grow, thro' the body of the flower. It
would



Imperial Anemone.

would not be strange to reason that this should be more common. The termination of the growth of plants, at the flower happens only because seeds are formed there : In these double flowers no seeds are produced ; therefore the usual cause does not obtain. The occasion that this second growth is less frequent, is the great degree of fullness in these double flowers : as much nourishment being perhaps required for them, as would be for the seeds.

C H A P. IV.

Of the proliferous GEUM.

THIS very peculiar plant, which is often proliferous in the wild state of nature, will confirm in some degree the observation made at the close of the last chapter ; for it becomes proliferous without being double. This luxuriant state of it, which nature offers, is indeed usually but imperfect in our country : but there are places where 'tis vigorous and elegant. With us the production of a second flower, and that scarce able to expand its petals, is all that we find wild ; but on the Pyrenæan mountains
nature

nature often raises the flower to the third stage perfect, and yet keeps all single.

GEUM is a name which the new Botany gives to the plant before called, from the spicy flavour of its root, CARYOPHYLLATA. The species which becomes prolific is native of our northern counties; and in the place of the little yellow and fugacious flower of the common kind, this has it large, permanent, and purple. 'Tis called *purpurea* from the colour of the flower, and from the place of growth sometimes *montana* and *palustris*: it demands both epithets, for its most favouring seat is at the edges of those bogs which are upon the tops of hills.

THE flower is naturally not unlike the Crowfoot. It has a divided cup, and in the simplest state has only five petals, with numerous filaments, and as numerous rudiments of seeds, covering a short blunt receptacle. In this state 'tis common in the upland bogs of *Yorkshire*; and as frequent in *Wales* and *Ireland*.

WHERE the nourishment is any thing luxuriant, the petals encrease in size and number: Eight usually take the place of the original five; and they spread out more flat.

THE next redundance is uncertain; for it depends on the nature of the ground.
If

If the mould be rich but shallow, as is the case upon the sides of our hills in *Westmoreland*, the filaments form petals ; and the flower grows regularly double. It becomes then globular as the *Ranunculus* of our gardens : But where the soil is deep ; and is moist also to the bottom, as 'tis in the high boggs of *Scotland* ; and on the west parts of the *Pyrenæan* mountains the flower becomes at once proliferous, without any farther doubling than a small encrease of its single or natural range of petals.

THE figure here annexed is from a *Pyrenæan* plant ; and these were its exact dimensions. Sibbald in *Scotland* long ago saw something like it.

IN this specimen the petals of each flower were eight ; they were large, waved, and spread out flat ; resembling more the *DRYAS* than the *GEUM*. The filaments held their place unaltered ; but the stalk of the plant, instead of terminating in a receptacle of seeds, grew through the first flower, and at some height above produced a second : then, growing thro' that also, it bore on its summit a third, in which the receptacle of seeds was perfect.

THE facts are certain as to the places of growth of the plants which have these several redundances ; and this will lead us

D

one

one step towards the great article of raising such flowers by culture. Mr. LAWSON, celebrated in the English botany, found this purple GEUM with four or five ranges of petals, near GREAT STRICKLAND in WESTMORELAND ; and long before him Mr. BREARCLIFF in a wood on an estate of his own name. In both these places the soil is rich but shallow. The Scotch bogs, about whose edges SIBBALD found the same plant, are generally compassed with a deep black mould, such as that of our English fens : and finally the place where the plant was gathered, from which this figure is taken, Pl. 4. was moist and mellow, to a depth beyond the full length of a French walking-cane. The least particularities in nature are to be regarded : the rational assistances of art depend on them entirely.

C H A P. V.

Of the Proliferous ROSE.

FOUR of the five properly proliferous plants are of the POLYANDROUS kind. The character of this class is that the filaments are numerous, and arise from a receptacle ; not from the cup or petals of the flower ; as they do in some others which



*Pyrenean
Geum.*

which have also great numbers of them ; and are thence separated under the term Icofandrous.

THIS is a particularity that demands notice. We know the filaments are formed of the essential part of the plant, that is the fleshy substance in the stalk. And we shall find on a proper search the receptacle in these peculiar plants has also a portion of this fleshy substance ; but the blea forms the greater part of it.

The natural termination of the flesh of the stalk is in a vault or arch which makes the top of the receptacle. When this arch is form'd at that place, the blea ceases to extend itself in height ; and there it terminates the plant. But if the blea can, by art or nature, be pushed up farther than this its general termination, the fleshy substance will accompany it ; and when it has ascended an inch or somewhat more, a new flower will be there form'd ; and it will in this state finish in that flower. The receptacle in this plant, tho' imperfect in the lower flower, will be natural and entire in the upper one.

THUS is form'd, and thus perfected, PROLIFERATION IN ONE STAGE. If a farther redundance of peculiar nourishment continues to push the blea yet farther, the same course will be observed by
nature,

nature, and a third flower will be formed upon the summit of another portion of the still ascending stalk.

FARTHER than this I have not seen proliferation reach : The wonder is, that it can go so far.

THE root of every plant has a peculiar force of imbibing ; and of propelling upwards the juices which it obtains from the earth. On this depends the height of the stem : for where that force ceases, the flower is form'd.

WHEN the juices can be carry'd no higher, the parts which would grow into leaves unite and make a cup ; and the other constituent parts of the plant stop in the same manner, and terminate in the same place ; forming the various portions of the flower. This is the system of FLORESCENCE ; and on this depends doubleness : for if any accident of culture, or abundance of wild nourishment of a right kind forces out the flower below the proper standard of growth, I have observed that it becomes usually double. This happens because 'tis better supply'd than it would have been at the extream height of the stalk.

WHATEVER nourishment encreases particularly the fleshy substance of the plant gives it a tendency to burst thus
early

early into flower ; and to extend the filaments into a kind of petals : and in the same manner whatever peculiar nourishment feeds the blea, in a like manner forces up that part, even after the flower is formed : and thus is produced proliferation.

THESE are not useless researches : the the more we know of the real nature of the change, the better we shall understand how to promote it at our pleasure.

THE ROSE often approaches to proliferation ; but we rarely see that change perfected. When the encrease is complete no vegetable has it so elegantly. In the Geum, just nam'd, and in the Carnation, to be described hereafter, the upper stalk, placed between flower and flower, is naked : but in the Rose, when perfectly prolific, it has a leaf upon it, like those upon the young shoots of the same shrub.

THE blea is plainly in this, as in the other instances the part which ascends from the centre of the original flower : for the natural outer rind has terminated in a cup ; and the inner rind in petals. Yet this ascending blea does not continue naked : it forms itself first an inner rind from its own substance, and then an outer bark from that. Those integuments, and even the blea itself, were originally thus formed in the seedling plant, for the
Co-

CORCULUM or heart of the seed bursts from its covering naked ; and as it swells for growth, forms these parts for its covering.

It is a great deal for the strength of nature at that height of the stalk which a forced nourishment has form'd above the proper flower, to furnish out these Coverings for the blea : but in the plants just named it does no more. In the *Ane-mone* sometimes a jagged film appears upon the stalk between the flowers, but in the *Rose*, often a perfect leaf.

This being a hardy shrub has longer fibres, and a more vivid blea than the herbaceous kinds ; and thence has this pre-eminence.

PECULIAR seasons favour the exuberance : but there must be also suitable soils to render the flowers perfect. The last summer was one which tended to this elegant production, and I saw several in the English gardens ; but all far from perfect. The best was one at Mr. **WARE'S** on **WESTBOURN-GREEN**, but the proliferation was but of one stage ; and the upper flower a very poor one.

THE specimen represented in the annexed figure I received from Germany, with the specious name of **REX ROSARUM** King of the Roses, or the sovereign Rose. See Pl. 5.

THE



*Sovereign
Rose.*

THE stalk on which the original or lower flower grew, differed in nothing from that of common roses. The second was supported on a new stalk, formed by a singular continuation of the first; and the third in the same manner on a new stem a continuation of the second. All three were perfect, and the stalks between so vigorous as to have leaves.

IN the instances hitherto examined the new stalk has been always form'd by a continuation of the receptacle of seeds raised within the flower; but in the Rose there is no such receptacle. The branch swells at its extremity into a peculiar kind of fruit; within which, not upon its surface, are placed the seeds; and from whose summit, not from its base, rises the proper cup of the flower: The petals and the numerous filaments having their place within.

THE doubleness of the Rose is made by some of the filaments swelling into petals; and in the perfect full kinds all of them undergo this change. The inner part of this fleshy fruit is form'd of the pith of the stalk, and this has for its covering the extream part of the fleshy substance, over which lies the blea. The fleshy substance naturally breaks into filaments at its extremity: but if abundant nourish-
ment

ment of a proper kind forces the blea to ascend higher than the body of the flower, a part of this substance always accompanies it ; and new coats are formed on that, as soon as it is exposed to the air. Thus a new stalk is produced with all its parts, supporting a second Rose ; and in the same manner afterwards a third.

C H A P. VI.

Of the Proliferous CARNATION.

THE Carnation is a single instance, so far as I have seen or heard, of a regularly proliferous plant, which is not of the polyandrous tribe. This however comes near to that class in place, tho' it does not enter it. 'Tis one of the DECAN-
DRIA, and has numerous filaments in the natural state, tho' they be not so abundant as in those other plants : perhaps therefore the prolifiration happens rarely.

THERE is something peculiar in the manner wherein the Carnation becomes thus redundant in flower ; for it has not that part from whence the new stalk is formed in the preceding instances. The seeds in this plant are not fixed to a receptacle, but lodged in a capsule : and as it is the receptacle which becomes extended into a new stalk in those kinds, it
is

is the rudiment of the capsule or seed vessel which furnishes the matter of the change in this.

IN the CLOVE-JULY-FLOWER, from which this Carnation is raised by care and superadded culture, the stalk is carry'd entire to the base of the cup. There its outer rind makes the four scales at the bottom, and terminates in them : The inner rind forms the long tubular cup of the flower, which gardeners call the pod of a Carnation : The blea makes the petals ; and the fleshy substance terminates in the filaments, except that a small portion of it covers the body of the new form'd capsule, whose principal substance is a termination of the pith.

THIS is the natural state of the flower. The rudiment of the seed vessel, whose origin is from the pith and a portion of the fleshy substance only, gets itself new coverings even in the flower, analogous to those it lost by their going off in the petals, and the cup : If we cut a young seed vessel transversely, we see them all tho' very small in quantity. They terminate at its summit in this natural state of the bloom ; but abundant nourishment may, as in other instances, extend them higher : and in that case a second flower is the natural and necessary consequence.

E

THE

THE change in the Carnation proceeds just as in the Ranunculus, the Tulip, and the like, so far as doubleness is concerned : An abundant nourishment of the fleshy substance connects the little filaments into broad petals : ten are thus added to the flower ; and afterwards by their splitting flatwise often twenty.

IF there be still redundant, rich, and proper nourishment after this, the farther growth gives proliferation. It is perfected thus.

THE fleshy coat of the young seed vessel forming itself fresh coverings in the flower, the first and nearest to it is a new blea. This is there coated with its two rinds ; and instead of terminating in a kind of arch at the top of that rudiment, it grows upwards ; rises from the center of the flower its natural bed ; and taking with it a portion of the fleshy substance within, and its two coats without, the whole thus becomes a new stalk.

THE plant had before reached its due natural stature ; and the tendency it then had to flower still continues : so that at a small height the parts arrange themselves for flowering a second time, just as they did below. They are all of them seen distinctly in this upper stem, as well as in the lower, and therefore, if nourishment enough rise,
this



*Supream
Carnation.*

this flower also will have all its parts, and be perfect. The specimen whence this figure was designed, had them truly so: the upper flower had all the parts of the lower, and one more; for in it was a rudiment of a seed vessel: there were fewer petals in this flower than in the lower, but that is not essential. See Pl. 6.

THE plant was raised in Italy, and stood in an open border, as did also another, like this but inferior, which flowered in the same garden in the year 1753.

C H A P. VII.

Of the Chicken CHAMOEMILE.

THE DAISY, when it has been raised from its plain state to doubleness, and to proliferation, has been resembled with its little sideling brood to the hen and her new hatch'd young ones. This Chamœmile may retain the name; as it has perfectly the form and nature of that pretty plant, in the whole composition of its flower.

THE sense of the term proliferation justly admits this species: for new flowers are produced from the same base with the old; but they are disposed altogether differently; These syngenesious plants are a peculiar tribe: each flower in them is properly a cluster,

cluster, or congeries of many ; tho' one cup holds them. The yellow tubular floscules which make the center in this Chamœmile, and others, in the state of nature are so many perfect little flowers : Each has its filaments and rudiment of fruit : and even the rays at the verge, tho' very different in form, approach to them in nature. Each of these has the rudiment of a seed which is to be impregnated from the farina of the others.

THE original flower whence culture has now raised this elegant redundance, consists of a great yellow head surrounded with a single series of white rays ; the yellow head being composed of tubular floscules.

THE method wherein this flower becomes doubled is exactly the same with that of the other composite kinds, which I have given at large in a late work * : The yellow and tubular floscules becoming white and flat by an easy and gradual change. Each of these is originally form'd of one petal, cut at the end into five segments : and within it stand five filaments, with coalescent antheræ.

WHEN luxuriant nourishment urges the growth of the flower beyond the intended limits, one of these five segments extends
itself

* Exotic Botany.

itself first, beyond the rest in length, and becomes whitish at the end. In the next stage this enlarged segment of the yellow foscule becomes yet longer, and takes into its substance the two others which are next it. 'Tis then plainly white : the filaments fade within it, because the nourishment goes to this part ; and the foscule becomes a mongrel, of a middle nature ; being neither altogether flat nor wholly tubular ; nor altogether white nor entirely yellow. The next stage lengthens it yet somewhat more ; it becomes entirely flat, plain, and white ; and is like altogether to the original verge of petals, round the flower, only shorter. These new petals lie like scales, in many ranges, one beyond another ; and the flower being of a snow white, and from the multitude of the new petals, almost globular, it has a fine appearance.

THUS is the double Sea-Chamœmile of the English Gardens form'd from the wild Italian plant, whose flower hardly exceeds the coarse aspect of our common MAY-WEED. But this is not all. Redundant nourishment, a depth of soil, and sea-weed for manure, have raised it this last summer, in Lincolnshire, to a new perfection ; rendering it, in its way, proliferous.

FROM

FROM the full double flower in this new state there arise no less than six of the proliferous order. They take their origin, not from the centre, as in the kinds just nam'd, but from the sides ; and tho' they very exactly resemble the original flower, they are but diminutives.

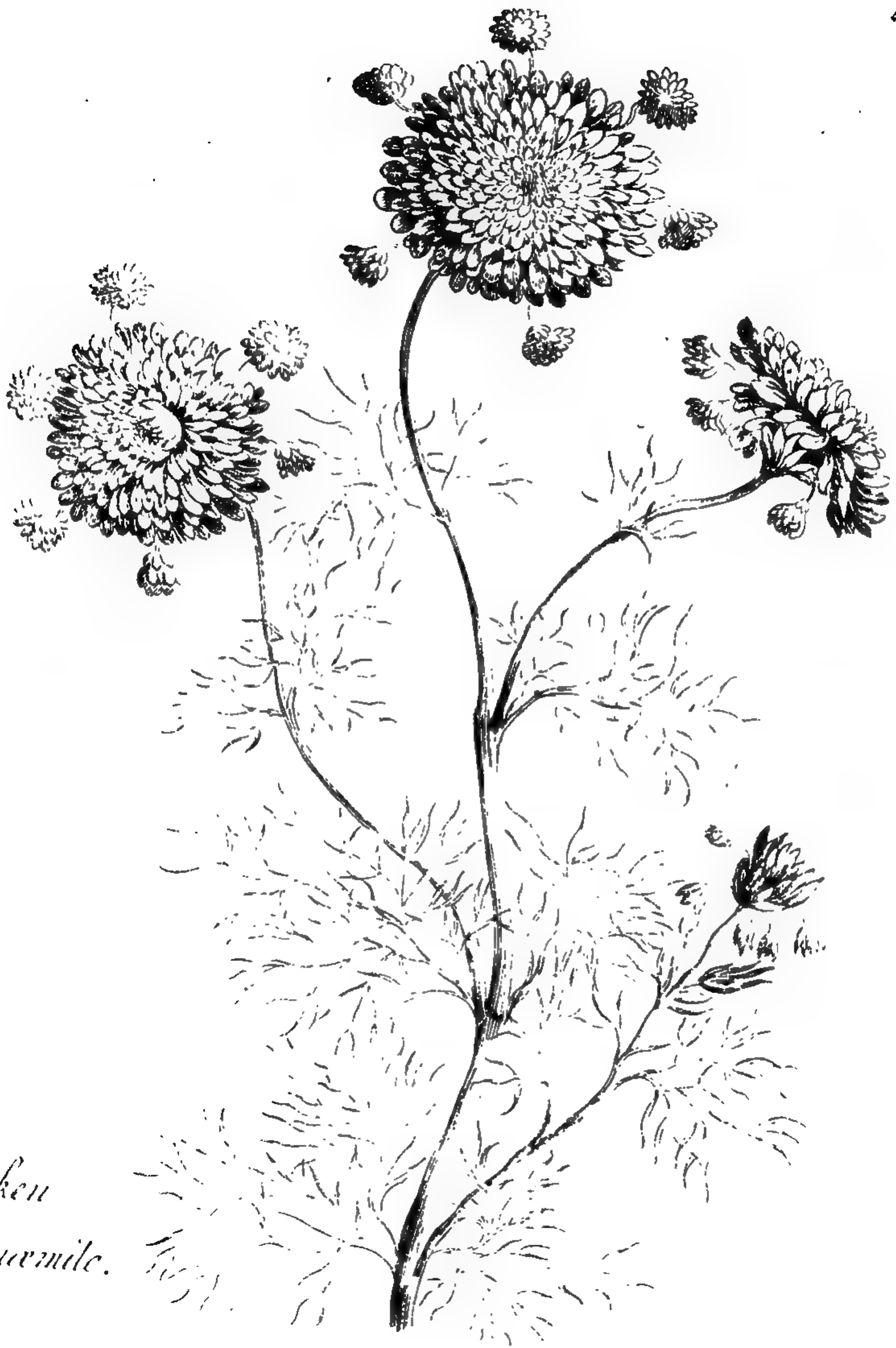
ONE rounded cup contains the many floscules which compose the original flower ; and these miniature productions rise from the swelling at the summit of the stalk just within that cincture : each with its own small footstalk. In the entire plant the outer rind having form'd the cup, there terminates : These footstalks of the new flowers therefore rise divested of an outer coat ; but this is a part as easily producible in plants as the outer skin or cuticle in animals : the young stalks soon get that additional covering ; and there is nothing to prevent their terminating as the rest in perfect flowers ; only that full nourishment is not easily convey'd to such a numerous and distant progeny. See Pl. 7.

C H A P. VIII.

Of the Production of LUXURIANT FLOWERS by Art.

I. THE SYSTEM.

WE have thus traced with slow and cautious steps the course by which the
the



Chicken
Chamomile. *Tag.*

the encrease of flowers is form'd, whether in doubleness, or proliferation : and the enquiry into those peculiar circumstances which attend these productions when they are the work of nature, will lead us by a plain detail of reason toward the means thro' which the same encrease may be rationally attempted by art.

ADVANCES in these paths are very slow. Gardening, which is a subject equal to the most exalted philosophy, is in the hands of ignorant men, and little understood : Certain knowledge is therefore difficultly attained, in whatever has concern with culture. Yet under all these disadvantages the search of truth has been continued, at my instigation, in different parts of the kingdom, and seems to promise fairly toward our encreasing the number of double and proliferous flowers.

THE general method, and the great first material I have given in a preceding work *, not being able then to go farther. The result of several of the trials had not then been transmitted me ; and 'tis not a subject on which to indulge conjecture. Discoveries, tho' ever so imperfect, have their value ; but fancy and vague guesses would render all confusion.

THE

* On double flowers,

THE principles are these. Of the five substances which constitute an entire plant, two only are concerned in the doubleness and proliferation of the flowers here considered. These are the blea and the fleshy substance; the third and fourth parts, counting from the surface. The fleshy substance breaks into the filaments, which, when they become luxuriant, form petals, and occasion doubleness: The blea, when it is made redundant, rises into a stalk beyond the flower, and gives proliferation.

THE luxuriance of the fleshy substance is owing to an encrease of nourishment: and so is the redundance of the blea. But an encrease of general nourishment affecting all parts equally, only enlarges the entire plant.

THERE are peculiar soils which encrease particular parts of vegetables, and they must owe this to particular ingredients.

IN some parts of Northamptonshire the ASH grows so tall and fine, that the most incurious cannot but observe it. On examining some of these trees when fell'd, I found the blea bore an over proportion to the rest of the parts; and that it had obtain'd also a peculiar close and even structure. A well which was then digging in the neighbourhood, gave opportunity of examining the soil. The upper coat
of

of mould was not deep : a broken stratum of stone lay under that, and beneath this a bed of a loose clay. Under these three lay a stratum of vast depth, moist, mellow, and full of the remains of vegetable matter ; such as we see in bogs ; but moulderling to dust : this, tho' moist, was not absolutely wet ; and it was encompass'd with an absolute fenny mould. Into this peculiar bed of earth I found the Ash roots penetrated ; and doubtless 'twas to that accident the encrease of blea was owing.

THIS opinion is strengthened by the deep Scotch soil, which makes the Geum prolificous in wild nature ; and as we know an encrease of blea gives additional height in that plant, 'tis probable from the same cause, the Ash trees are in this place tall, as well as swell'd with this thicken'd substance.

THE Beach in Suffex has a peculiar excellence, as the Ash in that other county ; but it consists in a different article. The tree is no taller than elsewhere, but the *wood* is more in quantity and better. The blea is less in quantity in the Suffex Beech than in that of Buckinghamshire, but the wood is encreased and rendered finer. This is not universal in the county : the late Duke of Richmond was curious to examine

mine the timber in many places, and I had the honour to attend him : in some we found it thus particularly fine ; in others not : The cause did not occur at that time, but by enquiries since, I find wherever the BEECH was thus improved there was MARLE in the ground : Where that was wanting, there was no such excellence. We thus see the ingredients in a soil can occasion this encrease ; and this being sufficient, it were vain and idle to seek any other cause : at least this has a title to be received as the true, till we know a better ; and thus far we have a right to reason by induction.

THE parts of tender plants are the same in number and in nature as those of trees, only they are less firm. The outter and inner rind of an herb answer to the exterior and interior bark of a tree. The blea has the same name in both, as well as the same nature : The flesh or fleshy substance of the plants stem, answers to the wood in the trunk of the tree ; and the pith is the same in both.

TREES and plants are capable equally of having one or other of their constituent parts encreased by certain kinds of nourishment : We see what soils produce the effect with certainty in trees ; and it is highly probable the ingredients which give them

them that power will do the same in plants ; for the same cause produces naturally like effects. This also experience seems to confirm ; but the trials must be more than the time has yet allow'd.

As prolific flowers are usually produced from double ones ; to raise a plant to doubleness should be the first step towards proliferation. And our endeavours toward this last point will succeed best when we select a plant just raised by art to perfect doubleness. For tho' proliferation depends immediately on the blea rising beyond the flower, yet there is a necessity the fleshy substance of the plant accompany it ; and this will be most easily obtain'd, while that substance is itself newly made luxuriant. On this foundation it may be rational to make the attempt by the following method of culture : selecting the Geum as a plant in which the native principles of doubleness and proliferation both are strong and capable of exerting themselves even in wild nature. Marle encreases the wood in trees, and a deep vegetable soil the blea. When the first of these parts is encreased in plants, doubleness follows ; and when the latter, proliferation : Therefore these substances added to a soil by art, and assisted by the full effect of a good culture, will probably always,

ways, as they have plainly this year in some instances, occasion doubleness and proliferation.

C H A P. IX.

The PRACTICE.

IN July, when the purple Geum flowers upon its native Hills in Westmoreland or Yorkshire, mark certain plants for seed. Select such as have firm stalks, a healthy aspect, and large flowers. When the seeds are ripe, cut off the heads; shake off the seeds, and spread them on a shelf in a dry room: turn them often, and let them lie twelve days: Then tie them up in paper bags, and keep them dry.

Mix some rich pasture mould with pond mud, rotted cow dung and river sand: A barrow of each of these to a load of mould. Add three barrows of rich crumbly marle, and skreen the whole together. Let this be done in July, and the heap turned up once a fortnight.

IN August make the seed-bed with this mould. Defend it from the North winds, and let it be open only to the morning Sun. As soon as the bed is levelled scatter on the seeds: sift over them half an inch of mould; and once in three days water the ground: laying a mat over the bed, and watering thro' that, not to dislodge the seeds

THE

THE plants will appear in six weeks, and they must be thin'd to two or three inches distance. As the weather grows severe, earth up their tender heads, and in the extream frosts shelter the ground. Thin them again in spring, and keep the bed clear from weeds, and often watered, thro' the summer. The next August make a new and deeper bed of the same kind of soil with the first; and plant in it the seedlings. Allow them ten inches distance every way.

THEY would naturally flower the succeeding summer, but that must be prevented: It may be done by taking them up several times; and planting to a different quarter of the heavens. This I have found will keep the root a year longer before flowering, and it will be so much stronger for the full bloom. Then this and the marle give the great hope of doubleness. In the beginning of October take up all the roots; turn them about a fourth part of the horizon, and immediately plant them again. Do the same early in the spring; and twice more during summer; then let them rest for flowering the next season.

MANY of the flowers, when they blow in this manner, will be double; some more some less in degree, but all beautiful.

THUS

Thus are produced double Geums, and from the most double of these we may reasonably expect proliferation. We are to prepare for it thus :

In the autumn of the year preceding their flowering, mix up this Compost. Take five loads of rich black earth from a moist meadow : mix with it one load and a half of mould from the bottom of an old stack of faggots ; one load of rotted cow dung, half a load of pond mud, and two barrows of clean sand. Stir these together, and turn them now and then in the heap.

WHEN the Geums are in flower mark those which have the most vigorous aspect, and the doublest bloom. In August make a bed of this mould four feet thick ; and plant in it those Geum roots at a foot and half distance. Put them in five inches deep ; and keep the bed well cleared from weeds. Water it often ; and largely in dry seasons.

THE plants will be very fine the next year, and probably that season or the succeeding, will give proliferous flowers from absolute culture. These will exceed greatly what wild nature offers ; because they will be double as well as proliferous.

THE same course of culture may be easily adapted to all the other kinds, which we already know to be sometimes proliferous ; and may be extended to many new ones ; selecting always polyandrous plants.

T H E E N D.

DIRECTIONS to the BINDER.

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THE
S L E E P
OF
P L A N T S,
AND
CAUSE OF MOTION
IN THE
SENSITIVE PLANT,
EXPLAINED.

By J. HILL, M. D.

In a LETTER to
LINNÆUS.

The SECOND EDITION.

L O N D O N :

Printed for R. BALDWIN, in *Pater-noster-row*.
M.DCC.LXII.

Advertisement.

THE public will please to excuse any particularity of style in the succeeding pamphlet ; since its appearance is accidental in this form. I promise myself so much indulgence from their candour, when they shall know it was originally intended to be no more than the title expresses ; a private Letter to a foreign Naturalist.

There is a freedom of style, and assured manner peculiar to this kind of correspondence, which would be too assuming in works addressed immediately to the public ; and might not unnaturally draw upon the author a censure of self-sufficiency and vanity. This explanation, I hope, will defend me from so unfair a charge : for indeed no one knows more the narrow limits of human knowledge ; or entertains an humbler opinion of the returns for years of application.

That the experiments which were the occasion of writing it, have added their mite to the stores of science, will be allowed ; for it has not before been known, that those changes which are brought on by night, in what are called the sleeping plants, and in the sensitive by a touch, could be at our pleasure occasioned at any hour ; and without the touch, or any other motion.

As this depends solely on removing the cause which kept them awake (so it is the fashion to speak), and expanded, it will be allowed also that cause, though hitherto undiscovered, is known.

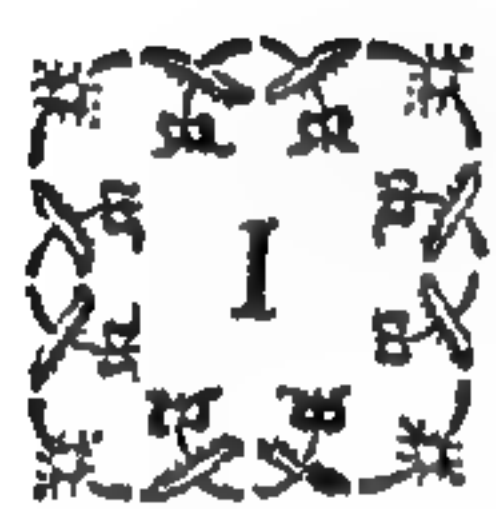
This is the utmost of the discovery ; and from this I persuade myself nothing can be taken.

The word Sleep, used on this occasion, will, I am afraid, appear to the judicious British eye, an affected, as well as improper term : but the application of it lies at another's charge ; and perhaps the manner of the country where he is native, will excuse it. Having thus disclaimed the word, I shall be pardoned for using it in the following discourse, when the reader considers it as a private letter, written to the person who first adopted the expression.

The preserving that term, and publishing the whole with the particularities which gave occasion to this apology, has been owing to a strict regard to truth ; which prompted me to lay the letter before the public unaltered, rather than amended : nor has the publication of it in England, where the taste of science is not general, any other motive, than to save the tediousness of transcribing, for the use of a few, who have been pleased to flatter me by their desire of preserving the discovery in its original form.



TO THE CELEBRATED
LINNÆUS.

 T is not strange to you to be addressed from remote countries ; nor in the cause of science can it be unwelcome.

Probably you have less expected this from me than any other ; but I will not suppose you have less desired it : The same pursuits have a long time engaged our attention ; and it could not be that I should pass over your great name in silence. If our opinions have differed, 'tis upon a single point ; your arrangement of plants. In regard to that much greater article, the establishing their distinctions, and ascertaining their characters, I have always admired and revered you : to dispute your determinations there, were to deny the characters of nature.

Free in the tribute of applause on this head, I have on the other been as open in my censures ; equally uninfluenced by envy, and by fear. It is thus science may be advanced ; and you will permit me to say, thus men of candour should treat one another. In this light I persuade myself you have always seen
my

my conduct toward you : that you have read with the same equal temper the censures of the *British Herbal*, wherein it came before me to examine systems ; and the just applause of *Eden*, where the characters of genera, and distinctions of species were most to be considered ; and that you will receive these impartial thoughts with more satisfaction, than all the little flattery of your pupils, or ignorant applause of those who have not understood your writings.

Systems are vague and unsubstantial ; but those distinctions are invariable and everlasting : and many distributions may be formed upon the discoveries you have made of them. In this essential part of botany you have alone done more than all who wrote before you : and I am convinced you will entertain no enmity against me, who with equal freedom point out these excellencies, and what have appeared to me your imperfections ; that you will read those censures with no more resentment than I wrote with malice ; and will see on what foundation to build your fame : for I have often said, and the world will say it, your system is repugnant to nature, although your characters are her own.

This is the opinion I entertain of you ; and in this confidence address to you the present treatise : an attempt to explain the cause of a quality in vegetables, whose effects none has observed with so much diligence or accuracy as yourself.

SECTION I.

That the leaves of certain plants assume at night a disposition different from that of the day, has been long known; *Acosta* records it of the Tamarind; *Alpinus* of that tree, and of the *Abrus* *; and from these, all who followed: *Alpinus* extends the observation to several other of the *Egyptian* kinds; and you have carried it much farther among the *European*.

That Author conceived it a provision of nature for the defence of the nobler parts, the flowers and fruit: and he particularly observes of the Tamarind, that its leaves embrace the tender pods.

This opinion *Ray* disclaimed, though he allowed the fact: but you have adopted it. I think it will appear upon a strict examination, that the change itself is a natural effect, resulting from the common properties of bodies, and their operations upon one another; and that the author of nature has in many instances made it effectual to that great purpose; though in others it happens equally, without answering such end.

We see how far the observations of earlier writers carried the discovery; how much farther your own: and I persuade myself you will accompany me with satisfaction in a more deep research.

* *Glycine foliis pinnatis conjugatis, pinnis ovatis oblongis, obtusis.*

You have deserved greatly of the world in this and other instances, by tracing nature's steps, and recording those observations. To relate these facts is to give the history of nature: but there is something more within our reach: The human mind, daring, though weak, and inquisitive under all its limitations, seeks, and sometimes not unhappily, their causes.

There have not been wanting from the time when this property in vegetables was first regarded, some who have sought its origin; but all yet unsuccessfully. Those who supposed it the effect of heat and cold, might for a long time seem to have judged rightly; but when we find the same thing happen with equal regularity in stoves, where there is no change in the temperature of the air, we are convinced that opinion cannot be just.

They were as far from truth, who supposed the health or sickness of the plant of any consequence in this respect; nor can I affirm that I have found nature in all instances confirm your observation, that it is more obvious in young plants than old.

It will appear from the following trials, that the sleeping and the sensitive plants are naturally allied; that their motions, though differently brought on, are dependent on the same principle; that many of the sleepers approach to the quality of the sensitives; and that all the sensitives have theirs.

This will shew the subjects are connected, and the principal experiments will prove, that,
with

with this connection, the principle of their motion is also found.

If I can close the Abrus leaves at noon-day, and open them again at pleasure, you will own, I know the principle of their change of position.

If I can throw down, as well as close the leaves of the sensitive plant, without a touch, by removing the power which keeps them erect, and expanded, you will acknowledge the latent principle of their motion is also understood.

We always know the cause of those effects we can ourselves produce; and experiments are the true test of reasoning.

S E C T. II.

We see a great number of plants close their leaves at evening. The fact is as obvious as it is strange: but we know every effect has its cause; and we are to seek this, not by vague conjecture, but in the established properties of bodies, and their known influence, in different cases, upon one another.

The structure of plants we may easily know; and of no part more perfectly than of the leaves: for a good microscope shews their smallest veins.

Between the two skins of the leaf, which are continuations of the outer rind of the stalk, there run innumerable fibres of a larger kind; with clusters of more minute ones, in various forms among them.

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The large vessels are of a woody substance ; hollow ; and smaller all the way from the base of the leaf : they are collected together in a compact manner in the footstalk ; with delicate clusters at its base : and they are originally sent from the stem.

They serve to support the leaf in its proper position ; and therefore whatever external or internal cause affects them, will change that position.

This is the construction of the part to be influenced ; the question remains, what it is that affects it ; and to know that we are to examine whatever may have such power.

Leaves thus constructed are always surrounded by the air ; and they are occasionally and variously influenced by heat, light, and moisture : The air also itself being in a continual state of variation, its alterations are to be considered as possible subordinate causes of change.

These things, and these only, come within contact of plants, or within the sphere of influence. Bodies do not affect bodies, but on contact, or within that sphere : therefore the cause of the change of position in leaves, is to be sought among these agents, and no other.

They are naturally complicated, and they act on most occasions together. We are therefore to observe, first, what effects result from their mutual combinations in a state of nature : and having assigned in these cases the effect to the proper and particular cause, from this power of that agent, whichever it is, that
acts

acts thus in concert with the rest, we may deduce its operations singly.

S E C T. III.

Pinnated leaves, such as are composed of numerous lobes, or smaller leaves placed on a common foot-stalk, are most remarkable for their change of position: it will be therefore best to wave all other consideration here; and observe solely the condition of these.

The four agents we have named are universal; but we shall find their operation differs in various climates. In these temperate kingdoms, our native plants which have pinnated leaves, naturally hold the lobes nearly horizontal, and shew but a moderate sensibility in this respect; in the hotter regions of the East, the usual position of the lobes in these plants is turning upwards, and they are extremely susceptible of change of posture; in *Ægypt* most of all: in the more northern nations, on the contrary, they scarce ever reach an horizontal position, and they shew very little change on any occasion.

As we see different appearances in these parts of plants in hot, temperate, and cold climates; observations of a like kind shew, they are not less variously affected in the same kingdoms in rainy and fair seasons. In those places where there are regular periods of rainy weather, the change in the face of the pinnated plants is very great, and certain: Those which in the fair months carry their lobes in

an obtuse angle upwards, constantly hang them obtusely downward in the time of the rains.

These are the observations of curious voyagers ; and they have been confirmed by the immediate notice of botanists in those places. The first would seem at once to give the effect to heat ; and the other to moisture : but farther observation shews it is otherwise. You have justly observed, that the same thing happens to plants in the stove, where there is no alteration in point of heat ; and I have found by careful trial, that moisture has in the same respect no effect : I have for this purpose watered some plants almost to destruction, and left others of the same kind dry ; and no alteration has been made by this : They all expand, or raise their leaves in the morning, and drop them in the evening ; at the same hour and in the same degree.

Two of the four natural agents, heat and moisture, are therefore excluded from any share in this effect : the air is too universal, and its changes too much depend on these, to be admitted in the research. The attention therefore falls on light alone : and I have found by many experiments, that the change of position in the leaves of plants at different periods of the day and night, is owing to this agent and no other. This is the discovery I persuade myself I have made ; and I shall endeavour to shew, that it is founded on reason, and supported by experiments.

Nor is there any thing strange in the effect, when duly examined. By excluding the supposed causes, we have discovered the real, for
there

There remained no other: and in examining the subject, on the principles here laid down, we shall find not only that no other power could produce the effect; but that light inevitably must.

These are the discoveries on which the everlasting seal of truth is stamped; which reason dictates; and which experiments confirm.

S E C T. IV.

We have proposed to search the latent principle of this change in the qualities of bodies, and their natural operations upon one another.

We have shewn what is the structure of leaves in general; and it will now be proper to fix on some one in particular: Let us chuse for this purpose an *Egyptian* plant, since those shew the effect most of all; and among these none can be more proper than the *Abrus*, celebrated for it by the earlier writers.

The leaf of this plant consists of thirteen pair of lobes, fixed by very short and extremely slender footstalks to the middle rib; and this to the main stem of the plant.

Examining its internal structure by the microscope, we find a number of delicate fibres, rising from the central part of the main stem, and continued in a course obliquely upwards, through the intermediate parts, and to the out-side of the rind. Here they swell; and run into several regular clusters, spreading downward and on each side; and these form (under the continued covering of the stem) the
base

base of the common footstalk, or middle rib of the leaf.

From this part they are carried in a small compacted bundle, strait forward to the extremity of the rib ; and there, as there is no odd lobe to close the leaf, they terminate in a point, covered by the common integuments.

From each side of this middle rib rise the footstalks of the separate lobes. They are formed of a multitude of delicate vessels, ranged close together, and confined by the covering, which is the common rind of the plant continued to that part.

At the base of each lobe there is another complex cluster of fibres. From this part they are protended forward, strait to the end of the lobe ; and they send out only slight branches into the several parts of the leaf.

This is the particular fabrick of the *Abrus* leaf, as seen upon a careful dissection, and with a good microscope : it agrees with the general construction, we have given before, as the common course of nature in these parts ; and it will regularly explain the change of posture in the lobes, under the different influence of light.

Light is subtile, active, and penetrating ; by the smallness of its constituent parts, it is capable of entering bodies ; and by the violence of its motion, of producing great effects and changes in them. These are not permanent, because those rays which occasion them, are, in that very action, extinguished, and lost.

Bodies may act on light without contact ; for the rays will be reflected when they come
extremely

extremely near : but light can act on bodies only by contact ; and in that contact the rays are lost.

The change produced in the position of the leaves of plants by light, is the result of its motion occasioned by its rays among their fibres : to excite this motion, the light must touch those fibres ; and where light touches, it adheres, and becomes immediately extinguished.

S E C T. V.

These are the everlasting and invariable properties of light : and, according to these, the change we attribute to it, being once effected, must be continued as naturally and as necessarily as it began, so long as the light continues, and no longer.

The raising of the lobes in these leaves will be owing to the power of those rays which at any one instant fall upon them : these become extinguished ; but others immediately succeed to them, so long as the air in which the plant stands, is enlightened. It ought therefore to be seen, that in full light, the lobes continue in their most raised position ; and that they droop from that in proportion as the light becomes less.

This which appears necessary from the powers of light, and the construction of leaves, is true also in fact.

We have seen that the footstalks of these lobes, are clusters of fibres protended from the center of the stem ; that they are continued
through

through the lobes ; and that they support them in their position, whatsoever it is.

The effect of light upon these fibres is the putting them into an incessant vibration : This happens necessarily from the continual impulsion and extinction of the corpuscles, of which light is composed, and the fresh impulsion of others, upon the extinction of the first.

It cannot be, but that a cluster of delicate fibres, affected incessantly by these concussions, must be put into a vibrating motion ; and this will be greater, as the light is more, and weaker as it is less.

This vibration is simple in the expanded fibres ; but it operates as variously as distinguishably on those clusters of them which are placed at the bases of the main rib, and of the several footstalks of the lobes.

It is on the operation of light upon these interwoven clusters of fibres, that the motion of the leaves in gaining their different position depends ; and consequently, the motion itself is various, according to the construction of those clusters.

In the *Abrus* they are large, and of a lax composition ; consequently the lobes are capable of a drooping, an horizontal, and an oblique upward position : in the *Tamarind*, and the broad-leaved *Robinia*, they are more compact, and hence all the motion of which those leaves are capable, is an expanding open, and a closing sideways ; which the direction and course of the fibres also favours ; in the *Parkinsonia* they are smaller, and yet more compact ;

fact; and the consequence of this is, that its lobes have no farther possible motion, than the expanding and closing upwards.

Hence the effects of a full light are different on various of the pinnated leaves; raising the lobes of some, as the *Abrus*, and opening or expending those of others, as the *Parkinsonia*.

The impulse of light, and the vibration it produces, are the same in all these instances: but the direction of that motion into which the lobes are thrown, is according to the course of the fibres; and the quantity of it, in equal degrees of light, to the construction of those reticulated clusters.

This universally appears on examination of the clusters of fibres by a microscope, and observation of the motion of the lobes: that motion being universally of greater extent, where the clusters of fibres are longer, and more loosely interwoven; and of less, where they are shorter, and more compact.

The effect of light upon bodies we see is to put their parts into a vibrating motion; the construction of pinnated leaves is such as naturally admits and propagates that influence; and the clusters of fibres are as a kind of joints on which their lobes are capable, under the influence of light, of a certain limited motion.

As the state of water uninfluenced by heat is ice, the natural position of the lobes in these pinnated leaves is drooping. This is their posture of repose: but in this they were not intended by the author of nature to remain;

main ; for vegetation is very imperfectly performed, while they are in it.

The effect of light is this vibration, and the alteration of position in those lobes. This is the doctrine here advanced, and this is supported by the following experiments.

S E C T. VI.

I removed a plant of the *Abrus* from a stove, in the evening of the seventh of August, and placed it in my study, where it could have the effect of moderate day-light, without being exposed to the immediate action of the sun.

This might be conceived the most natural and equable degree of light ; and therefore fittest for the first experiments.

The lobes of the leaves were at evening, when the plant was brought in, fallen perpendicularly from the middle rib, and closed together by their under sides.

Thus they continued during the night ; in a state of perfect repose. Half an Hour after day-break they began to separate ; and in a quarter of an hour after sun-rise stood horizontally ; flat, and perfectly expanded. Long before sun-set they began to droop again ; and toward evening they were closed underneath, as at first.

Next day the plant was set in a room where there was less light. The lobes were raised in the morning ; but not to a horizontal situation ; and they drooped earlier at evening.

The

The third day it was set in a south window, open to the full sun. Early in the morning the leaves had attained their horizontal situation; by nine o'clock they were raised considerably; and they continued in this state till toward evening, when they by degrees fell to the horizontal situation; and from that drooped gradually to the usual state of rest.

The fourth day the plant stood in the same place, but the sun did not appear. The lobes obtained early their horizontal situation, but did not rise beyond it; and in the evening closed as usual, below.

S E C T. VII.

These experiments shew the effects of various degrees of light: at the same time, that they prove the whole change to be occasioned by light only.

The effect of moderate light, that is, the light of a bright day out of the sun-shine, is to raise the lobes to an horizontal position: Less than this places them at an obtuse angle downwards: more, at an obtuse angle upwards.

The fifth day the plant was set in a less enlightened room: and the leaves had obtained by nine o'clock their position at an obtuse angle downward: it was then brought into the lighter room, and they rose to the horizontal situation in a quarter of an hour. It was then removed to the window, where the sun shone, and the lobes were elevated as

before ; and being thence carried into the less light room, they drooped again. All these changes were produced between the hours of nine and two, the weather the same, and only the place of the plant changed.

On the sixth day it remained in moderate light ; and kept its leaves horizontal.

On the seventh I made the final experiment.

It appeared to me, that if light were the sole cause of the motion, and change of position in the leaves, then denying the plant the benefit of light at any time, must bring on that change : that it would not be difficult to darken the place where the plant stood, at any time : and that the consequence of this must be, if the principles already laid down were true, a bringing on of the change at any time of the day. This experiment appeared as a just proof of the foregoing reasonings : if darkness would at any time throw down the lobes, the system of that motion before delivered must be true ; if not, that all the reasonings must be false.

The assent of the world must also depend on this. Deductions of reason may be disputed, but it will be allowed certainly, that we understand the cause of a change we can produce.

In the evening of the sixth day I set the plant in a book-case, on which the morning sun shines ; and throwing open the doors, left the whole to nature. The succeeding day was bright. The lobes which had met in their

their drooping position at evening, and continued so during the night, began to open early in the morning, and by nine o'clock they had passed their horizontal situation, and were elevated in the usual manner.

I then shut the doors of the book-case : the plant was by this left in darkness ; and on opening them an hour afterwards, the full change had happened : the lobes were all dropped, and it was in the same state that it would have shewn at midnight.

On the opening of the doors the change began very soon : and in twenty minutes the lobes had obtained their elevated situation. This experiment I have since many times repeated, and always with the same success.

It is in our power therefore to bring on this state of repose at pleasure ; and by the admission or exclusion of light, to make the plant at our own time put on all its changes, from the drooping to the most elevated position of the lobes.

We know that in these experiments, light alone is the cause : we are therefore certain, that what is called the sleep of plants, is the effect of the absence of light alone, and that their various intermediate states are owing to its different degrees.

S E C T. VIII.

This being explained, a second discovery follows naturally. The motion of the sensitive plant, at the cause of which no philosopher

pher has hitherto ventured a conjecture, is in a great measure owing to the same principles: and the explanation of it, which before the effect of light upon the leaves of plants was thus shewn, must have been enveloped in impenetrable obscurity, may now be regularly pursued.

The sensitive plant, beside its singular quality of closing and dropping its leaves upon the touch, is subject to the same changes with the *Abrus*, and those other kinds, we have named from the effect of light.

These natural, as well as the accidental motions on the touch, I have traced regularly in the common sensitive plant: but before we enter on the detail of those observations, it will be proper to remark, how nearly some other plants approach to the quality of this, and the other species of sensitive; which they have been hitherto supposed to possess alone.

This surprizing quality is a power of motion in the lobes and their footstalks. No change of position can be made without motion of the parts, therefore the *Abrus*, and all these other plants have also motion.

They agree with the sensitive in displaying this motion from the power of light; and all that remains particular in the sensitive is, that it is capable of the same motion from another cause. This is an accidental shock of its parts.

S E C T. IX.

Even that is a quality common to some other kinds, though in an inferior degree: for a Tamarind tree has lately under my observation, closed its leaves on motion.

A flourishing plant of this, a yard high, being brought from Mr. Lee's nursery at Hammer-smith, to me in St. James's Street, in the middle of the day, came in with its leaves closed, as it naturally has them at midnight, and as the sensitive plant on being touched.

An Abrus suffered no change under the like circumstances.

Hence we infer, that the same construction of parts, which gives the sensitive plant the power of motion, is in the Tamarind tree, though less delicate; so that a ruder shock is required to bring on the change.

It is in a lower degree also in the Abrus, for light has that power, though the effect cannot, so far as we have yet seen, be produced by a shock.

Plants which suffer this change from the effect of light, may, though they do not universally, shew it also from motion; and all plants which are capable of this change by motion, suffer it also from the absence of light.

Light gives their leaves that position, from which they are to be thrown by a touch: and the absence of light takes the same effect with that touch; though in a slower manner.

The

The sensitive plant at noon-day has its leaves raised and expanded. The footstalks make an acute angle with the main stem, and the two leaves which grow on each of the first or lower ones, stand remote from one another. The lobes which compose these, are about twelve pair to each, and these also stand in an horizontal direction.

Thus the young plant appears in the middle hours of day. At the approach of evening, the lobes begin to draw themselves together upwards, as in the *Parkinsonia* ; and the middle rib of each approaches toward the other : at night the lobes are as entirely shut upwards, as those of the *Abrus* downward, the two ribs are placed close to each other ; and the footstalk which supports them both, hangs down.

This is the state of repose of the sensitive plant : into this it falls every night naturally ; and into this it may, in the same manner as the *Abrus*, be thrown at noon-day in a darkened place.

S E C T. X.

As we have seen the cause of this change in the *Abrus* to be light, and have traced the manner of the operation ; it is easy to follow it also in the sensitive plant, through the same course of enquiry.

At the base of the footstalk, where it joins the main stem, there is a cluster of complex fibres : These have risen from the inner part, and pierced the woody sides.

From

From this complex cluster, the fibres proceed in a strait line up the footstalk, till at the head of that, where the two leaves rise, there is another such cluster: thence the fibres run strait the length of the main rib, and send out on each side other clusters at the base of every lobe. From these more minute fibres run strait through the leaf, and send out lateral shoots.

This the microscope discovers plainly; and this shews that not only the natural motions of the sensitive plant are the same with those of the *Abrus* and others, but that the construction also is the same in its kind, though more complex.

In the night the sensitive plant is not capable of the common motion on the touch, for the leaves are already in the condition whereto they would be reduced by it. In the day they rise and spread: and 'tis then the strange effect appears on touching them.

Light expands the lobes, separates the ribs, and raises the footstalks. It does this, by putting all the parts of them in a vibrating motion. This we have seen in the *Abrus*, is principally effected by means of those clusters of fibres which are placed at the bases of the footstalks. In this plant, as there are no less than three sets of those clusters, the effects of the same principle are naturally much greater than in the *Abrus*, where there is only one.

The vibration of the parts is that which keeps the leaves of the sensitive plant in their expanded and elevated state: This is owing to a delicate motion continued through every
D fibre

fibre of them. When we touch the leaf, we give it another motion more violent than the first: this overcomes the first: the vibration is stopped by the rude shock: and the leaves close, and their footstalks fall, because that vibrating motion is destroyed which kept them elevated and expanded.

That the power of motion in the sensitive plant depends upon the effect of light on the expanded surface of the leaves, is certain; for till they are expanded, they have no such power. The young leaves, even when grown to half an inch in length, have no motion on the touch, though rough and sudden.

To propagate the motion when the leaves are in a state to shew it, there requires a perfect and confirmed state of those clusters of fibres lodged at their base. This is evident: for when the young leaf has first come into the state of vibration, a touch will make its lobes close; but the effect is not continued down the footstalk, till it is more confirmed. No shock on the young leaf will affect the footstalk before it is expanded: hence the clusters of fibres at the bases of the lobes first acquire their due condition for motion; and afterwards those at the head of the main footstalk.

As there requires a due firmness to give the clusters of fibres the susceptibility of motion, and power of propagating it farther; there needs also a concurrence of favouring circumstances, to preserve them in that delicate state wherein they are capable of exerting these powers.

The cold air hardens the fibres and impairs their susceptibility of motion. The sensitive plant becomes more languid in this respect when removed out of the stove.

The correspondence between this motion, and what you have called the sleep of plants, or their natural closing of their leaves at night, appears also in this instance : for as the sensitive by being removed out of the stove, loses in some degree the quality of closing its leaves on the touch, the Tamarind by the same change loses in great part its quality of closing the leaves at evening. This is probably owing to the juices stagnating in the clusters of fibres, and to the contraction of the bark by cold.

The communication of motion is less from the lobes to the footstalk ; and greater from the footstalk to them. The greatest shock is given to the plant by a rude touch of the stem : but even this does not affect the unexpanded or young leaves.

The analogy between the effect of a sudden motion, and of the absence of light is confirmed also by this ; for as light decays naturally at evening, or artificially by shutting up the plant, the lobes first close, and the footstalks afterwards fall.

The power of absolute darkness is greater on the sensitive plant, than that of the rudest touch. The rudest touch will only cause the lobes of the separate leaves to close, and the footstalks to hang down : the two leaves will remain far asunder. The effect of absolute darkness exceeds this ; for the two leaves

close also absolutely together, and it appears as if the footstalk supported only one. This proves that the expansion of those parts depends solely upon the effect of light ; and that although it may be disturbed by a super-added and ruder motion, yet it can be taken away absolutely only by darkness ; by the defect of that to which alone it was owing.

These experiments every one may easily repeat : the observations will be familiarly made by any who have stoves : They are constant and invariable ; and the conclusions from them are certain ; for no other cause intervenes.

The effect of light is continual while the light continues. The plant therefore whose leaves have been thrown down, and closed by this rude shock, is immediately affected by the light, as at its first appearance in the morning, or as on its admission, when the leaves had been closed by artificial darkness. The vibration begins ; and if the light be at its full strength, the expansion and elevation of the lobes is so quick, that one may almost look upon the plant, and see it. A few minutes often perfects it.

That the touch of the leaves no other way affects them than by a motion greater than their own internal vibration, is plain from this, that if they be touched with a finger in so deliberate and gentle a manner as not to move them, no effect is produced : and on the other hand, if they be any other way moved, the full effect follows.

If the pot be shook, though no part of the plant be touched, the leaves close, and their footstalks fall : or if the wind blow them, the effect is the same.

Hence it is certain that the expansion of the lobes, and elevation of the footstalks in these pinnated plants, is occasioned solely by that vibrating motion, in which their parts are kept by the continual impulses of light : and consequently that in all of them they collapse or sink on the absence of light ; and in the more delicate kinds upon the shock of any ruder motion, which for the present stops that vibration.

Hence also the different appearance of pinnated leaves in various climates is understood ; and may be assigned to its true cause, which is the different degree of light.

In the East the lobes are expanded, not because of the heat, but because the light is strong : In the northern kingdoms they droop, not from cold, but because the air is less enlightened : In the rainy seasons they also droop, but it is not from the moisture, but the darkness of the weather ; and in *Ægypt* they are most raised of all, not because it never rains ; but because the light is constant.

The *Abrus* placed in a south window perfectly shews this ; for the expansion and elevation of its leaves is proportioned always to the degree of light, and consequently it is affected by the cloudy or clear weather, though the plant remain in the same place.

The

The lobes begin to rise before the sun is above the horizon, because the air is enlightened in a proportioned degree; and they begin to close again long before it sets, because in the south window the shadow of the building darkens the air about them.

In the rainy weather which we have now lately had, the leaves wore the same appearance they would have done in a plant native of a country where there are seasons of rain; they never at any time of the day reached the horizontal position, and they drooped much earlier in the afternoon, and began to expand much later in the morning.

The sensitive plant which was placed near the Abrus, was affected in the same manner: and by repeated and careful examination, I have always found, that in both these and in all others, the degree of elevation or expansion in the lobes, is exactly proportioned to the quantity of light; as it is solely dependent on it.

When the sensitive plant has been kept out of a stove some days, and has lost some part of its power of motion, if the leaf be touched softly, and the force encreased gradually, it will bear a great deal without drawing up the lobes; but at the same time a much less pressure given with a sudden stroke will occasion their closing.

In this manner we may also trace the extent and progress of the motion according to the force; a slighter shock raising only the lobes that are touched, a harder the opposite ones, and so the whole.

This

This quality in the leaves of plants, as their general structure is the same, and the same agent operates universally, ought to be found in all ; though in various degrees, according to the construction of their parts. In this, as all the preceding instances, just observation confirms the principles deduced from reason. In some it is greater, in others less ; in many obvious to the common eye, in others difficultly perceived by the most accurate ; but on a strict and close examination, I have not found any plant or tree wholly destitute of it.

S E C T. XI.

That the curious who shall chuse to repeat the experiments mentioned in the preceding pages, may find no difficulty in that respect, I shall give the particulars of the plants, and apparatus with which I made them.

The Abrus, Sensitive, and Tamarind, I obtained, in pots, from the nursery of Mr. Lee, near Hammersmith : a person whose industry and knowledge in his business, will some time make him known, to his advantage.

The microscopes were those of Mr. Cuff.

The Abrus was a flourishing plant, of two feet and a half high : the Tamarind something taller. The Sensitive was a young one ; in which state there are only two pinnated leaves upon each footstalk.

A plant of this growth is most manageable out of a stove, and was preferred for that reason ;

son ; but the same experiments made on those of larger growth, answer in the same manner.

The place where they were kept, unless when removed for the particular experiments which required it, was a south window.

The Abrus will live very well in such a situation at this season of the year ; and the Sensitive, with due care, may be kept in tolerable perfection in the same manner, a fortnight or three weeks ; though much more tender than the other.

The apparatus for the experiments, beside the microscope, consists only of a fine penknife, and a flat board, covered with a piece of cork, six inches long, and three broad.

In order to trace the course of the fibres, and see their clusters distinctly, a leaf of the Abrus must be pulled off, by slipping it downward. This brings away its base entire, and is necessary for obtaining in perfection the cluster which is situated there.

The leaf must be laid flat upon the cork, and fixed down by a small pin, thrust through the middle rib, a little above the place where the first pair of lobes are inserted.

There must be a good light, and a careful steady hand, and the point of the penknife must be kept sharp and clean.

It will be easy to let this in at the middle of the rib, a little above the insertion of the first lobes, and to split the rib thence equally to the base.

The object is neither too minute for the hand, nor the eye ; nor does it require those
powerful

powerful magnifiers, which are often needful, in the more delicate researches.

The cluster of the fibres at the base of the main footstalk, will be thus seen: they will appear cut more or less exactly in two, according to the division of the stalk, and their course and interwoven texture afford a pleasing object.

This is the first experiment to be made; and it is very happy that the construction is seen without great difficulty, for it leads the way to the rest, which being minute, require a more strict scrutiny.

The course of the fibres along the middle rib, and their clustering at the bases of the lobes, may be pursued by splitting the footstalk farther up: but as this is not easily done, I have been used to cut off the upper and under part of the leaf, and leaving only a piece, which has one pair of the lobes, and to cut it across in the centre of their bases.

This requires a careful eye, and a very regular pressure of the penknife; but with so much caution, it may always be done successfully.

At the base of each lobe there will be seen a cluster, in all respects resembling the first, only more delicate; and from that the fibres will be found continued in a strait course along the middle rib, as they are in the same way along the footstalk, from the first cluster.

This way the eye perceives that there are such fibres, that they are so clustered, and that their course is regular from thence. The fact is so ascertained, but to admire duly the con-

struction on which this motion depends, the fibres must be separated from all surrounding matter, and laid before the double microscope in water.

The method is this :

Let a leaf be pulled from the Abrus, as before, and in the same manner cut into two or three short pieces ; two lobes remaining with each : let the footstalk be split first at the base, and afterwards crosswise at each joint ; thro' the bases of the two lobes, and into the centre of the middle rib of each.

Let the ends of the lobes be cut off ; and a number of these pieces be put into a saucer of water, keeping them down by some little weight.

They must lie in this water two or three days, according to the warmth of the weather ; and at the end of that time they must be pressed gently against the bottom of the saucer, with a piece of muslin tied to the end of a pen, or other such implement.

This must be done with a delicate hand, and repeated often. They will be thus cleared from all surrounding matter. The firmness of their own texture will preserve them. They must be afterwards put into fresh water, and left four or five hours to swell and recover their first disposition ; and then laid in water before the double microscope. The course of their fibres in their simple and clustered state, will be thus perfectly seen, and the mechanism by which the motion in the lobes is performed easily understood.

The

The method with the Sensitive plant is to be exactly the same. The footstalk supporting the two leaves, must be torn off downwards, and the leaves expanded on the cork with pins, as directed for the other. The base of the footstalk must first be split with the penknife; then the base of each leaf on the head of this stalk, and after that the base of each lobe. The construction in this part is very obvious, for it swells up extremely, and appears as a kind of joint, to serve the motion.

The condition of the clusters of fibres when the footstalk is just split, is more or less distinctly seen according to the age of the plant, the place of the leaf, and the degree of nourishment. It is most distinct in a leaf taken from the lower part of a young plant; but not the lowest, or any placed so low as to be fading: and in the same manner the construction at the base of the lobes is best seen in the second pair from the base of the footstalk.

These directions will be useful to those who will not be at the pains to clear the parts in water: but that way there is no difficulty in bringing the whole plainly and perfectly to view. I am,

With great respect,

S I R,

Your Humble Servant,

*London,
Sept. 7,
1757.*

JOHN HILL.

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F I N I S.

ALERIAN.

O R,

The Virtues of that Root

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NERVOUS DISORDERS;

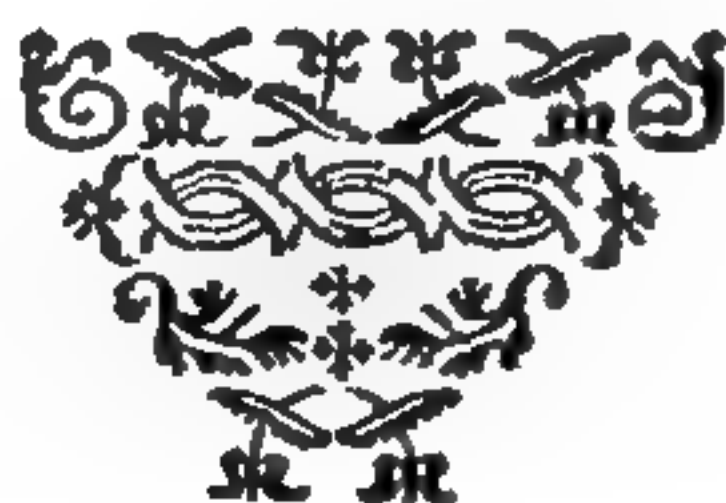
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The CHARACTERS which distinguish the
TRUE from the FALSE.

By J O H N H I L L, M. D.

Illustrated with FIGURES.

THE THIRD EDITION.

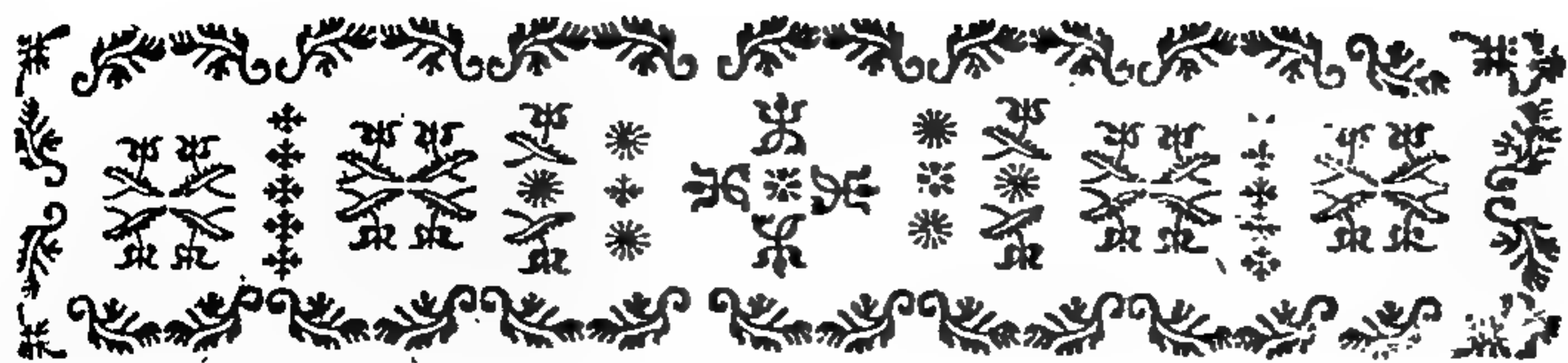


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V A L E R I A N.

I N T R O D U C T I O N.

PHYSICIANS find uncertainty in the effects of Valerian; and the medicine has lost some part of its credit: I beg they will hear the following reasons. When the causes of that uncertainty are shewn, the remedy will be easy.

By the application to these purposes botany becomes useful to mankind: and 'tis a misfortune the science is so little cultivated in England. Some should enquire into the state of drugs; and determine with equal freedom against ignorance and fraud: but this cannot be expected from the physicians; for the superior care of health does not allow them leisure: the age is not deficient in HIPPOCRATES's; but there wants a *Cratevas*.

C H A P. I.

Of the Nature of the Root.

BY VALERIAN, we understand the root of the large wild plant of that name: its superior virtues having banished the other kinds. This grows on heaths, by rivers, and in woods: but

does, not in all these places, equally possess its virtues. When in perfection, it is highly aromatick: we know that quality depends in a great measure, on sun and air; and is impaired always, and often is destroyed utterly, by shade and water; therefore the roots of Valerian which grow upon dry hills and sun-burnt heaths, possess its virtues in the highest degree; and such only should be used in medicine. Unhappily the plant is more common by waters; and the roots are in wet places larger, and more easily taken up. A pound of these is brought into the shops for a dram of the other: and as they are greatly inferior in their qualities, the physician is disappointed who depends on them.

Not only the virtues, but the stature, colour, and whole aspect of the plant are altered by this watery nourishment: and though in reality the two kinds are only varieties, occasioned by the different soil, yet they are so considerable, that Ray and others have given the mountain Valerian, a distinct place in their catalogues, accounting it a different species from that growing by waters.

In woods it assumes a form distinct from the other; and properly is of a middle kind between them. Its virtues are also of a middle character: inferior to those of the heath, and superior to those of water Valerian.

The excellence of Heath Valerian is such that no other should be used; and there is enough of it for the demand. The distinction is obvious, as will appear by the succeeding

ing



TRUE WILD VALERIAN

ing characters : and as the term WILD belongs equally to the wood and water kinds, as well as to the true, it may be proper to distinguish that hereafter, by the name HEATH VALERIAN.

C H A P. II.

Description of the Plant, and of the fresh Root.

THE root is composed of many fibres joined to a small oblong head. The stalk is erect, round, jointed, hollow, and toward the bottom, reddish. The leaves stand in pairs ; and each is composed of many lesser leaves joined to a long rib, with an odd one at the end. The flowers are small and reddish ; and they stand in large tufts at the tops of the stalks and branches. Each flower is formed of one piece ; and is tubular at the base, swelled out on one side, and cut into five parts at the rim. It has no cup : and each is followed by a single seed.

This is the form of the plant in whatever soil it grows. The distinctions of the heath from the water Valerian are these.

The HEATH VALERIAN is about two feet and a half high. The stalk is of a dusky green, and lightly hairy : the leaves are smaller than in the water kind ; and the little leaves of which each of the larger is composed, are narrower, and of a deeper colour : these are also covered with fine white hairs. The flowers are of a brighter red ; and the clusters of them are smaller. The seed also is less.

The

WATER VALERIAN is four feet high. The stalk is of a pale green, and thick ; the leaves are large, smooth, and broad, and they are also of a fresh pale green. The flowers are paler ; but in larger clusters than the other ; and the seed is larger and softer.

This is the distinction of the plants at full growth : but as the best time of gathering the roots is before the stalk rises, 'tis necessary they should be known also in that state. The place might indeed be a sufficient direction : for no one would go to gather the root by a river, when he has been told the Water Valerian is of less value. But that such as have not opportunities of taking it upon themselves, may have some mark by which to know when it is genuine, it may be needful to add, that many such leaves as we have described on the stalk, rise also immediately from the root ; and the same distinction is preserved in them : these in the Heath Valerian, are composed of narrower parts, and are hairy and dusky in colour ; in the Water Valerian, they are bright, smoother, and pale.

The great distinction is in the root itself. This in the true heath kind, is of a fine brown colour, tending to olive ; and consists of long slender fibres, which have a multitude of smaller threads growing from their sides in the manner of short curled hairs.

The root of the Wood Valerian is of a tawny, or deep brownish yellow.

The



WATER VALERIAN

The root of the Water Valerian, is of a pale brown tending to yellow ; and is composed of thicker and more naked fibres. There is lately introduced also a kind which has grown in absolute water : This is white, and is worst of all. The root of the Heath Valerian is firm and tough ; the root of the water kind is tender and more easily broken : the Heath Valerian root has a fresh aromack scent, with a very little foetidness. The water kind has nothing of this freshness in the scent, and little of the aromack ; but is in a manner heavy and foetid only.

By these characters the plants will be known in whatever period of growth ; and even the roots when brought without any part of the herb. But since many have not opportunities of seeing these when fresh, it will be proper to observe also their condition dry, at the drug-gists.

These are supplied with it by persons who want knowledge, and often honesty : there is therefore no dependance, except upon the absolute aspect of the root. The distinction in *this* article is the more necessary ; because the plant must be wild to have its virtue. Garden culture debases it almost as much as a watery nourishment abroad. This I have found by trial. Where a drug must be received from such hands, as usually deal in Valerian, it is necessary to be very well acquainted with its genuine characters.

C H A P. III.

The History of the Valerian of the Druggists.

TH E Valerian sold at our druggists is collected by certain itinerant medicine-mongers, whom, from the principal article in which they deal, we call VIPER-CATCHERS: these people who travel over the kingdom in search of those animals, bring in also Valerian roots, and some other articles.

As they find a hundred plants of the Water Valerian for one of the Heath kind, that is, the root they usually collect: if the other falls in their way, and will come easily out of the ground, as it will in the looser heath soils after rains, they mix it with the rest: if not, they let it alone entirely. So that we sometimes meet with great quantities of the water kind only; and sometimes a mixture of one and the other. The first should be refused entirely; and the latter carefully picked. Besides this mixture, they put in also the roots of a small Meadow Valerian, a distinct species: and other kinds less pardonably. I have raised a plant of the smooth water crowfoot, which is poisonous, from a root sold among Wild Valerian.

Even this is not all the disadvantage. The time when roots have their full virtue is before they shoot up a stalk; but the plant is most obvious when in flower: the root also at that time
is

is looser in the ground, and the stalk is a handle by which it is easily drawn up. For these reasons a great part of what is brought into the shops has been taken out of the earth when the plant was in flower; and is therefore, even though the kind were right, unfit for use in medicine. Of all these imperfections the druggist should beware; for his care will make the gatherers honest: if he be negligent, the apothecary should refuse to take such as is bad into his shop: and in case of both these being careless, the patient may examine the root himself, according to the following characters.

C H A P. IV.

Description of the false Valerian Root when dry.

THE WATER VALERIAN ROOT dried is *brittle* and of a pale brown, approaching to *yellow*: it is composed of many rounded fibres, which are often entirely *naked* or at the best hung with a very few threads; and at the head there are commonly seen the *remains* of a *stalk*, with a hollow equal to that of a goose quill. Among the true fibres of the root, are also several long and *thick strings* of a paler colour, and *jointed* as it were; with a kind of dent at each joint. These are the creeping appendages of the root, by which it runs under the surface: they have nearly the nature of stalks, and are as destitute of virtue as straws. When the real fibres of this root are tasted, they are a little acrid, but *faint*, and a foetid scent is perceived

ceived in them while chewing. If they are broken, they appear *hollow* in the midst, or at the best dark and *blackish*. In the first case, the pith of the root is consumed, which is the common state of it after the plant has flower'd ; the other is the natural condition of it in watery places ; and is a certain sign of its wanting strength. The substance which surrounds the pith in the Valerian root, contains its greatest virtue. This is spongy and woody in the Water Valerian, but in the heath kind, it is firm, and contains a substance approaching to the nature of a gum-resin. This a watery nourishment cannot supply ; and therefore that part in the Water Valerian is perishable, whereas in the other it is permanent.

C H A P. V.

*Description of the true Heath Valerian Root
when dry.*

THE TRUE HEATH VALERIAN ROOT is composed of long and slender fibres : it is *tough* ; and of a *dusky brown*, approaching to *olive* colour ; and the fibres are hung about with *numerous threads* : when broken, they have no hollow in the centre, nor any blackish circle there, but appear full and bright ; and if the root has been gathered in perfection, there is a circle of a greenish or pale hue surrounding the pith.

The taste differs from the other much more than the colour, or form : it is acrid, spicy, and pleasant ;

pleasant ; and after it has been chewed some time, there is perceived a slight bitterness, and some astringency. It may be always known by this from the false ; which is vapid and sweetish, scarce at all aromack, and destitute entirely of this latent bitterness and roughness.

Its virtues depend wholly on the principles which give this taste and flavour ; and they cannot be found in the other disagreeable and offensive kind.

This is the root, and this only, which should be gathered for medicinal use, and it is indeed a very valuable medicine. A physician of distinguished abilities, one of the late censors of the college *, has told me, that in a search, they found this true Valerian Root at one, and only one shop in London ; the powder was of an olive brown, and the scent aromack and agreeable : at other places, the powder was of a yellowish brown, and the scent offensive.

This true kind is liable like the false, to have runners mixed among the real fibres ; and they should be separated : it may be easily seen whether the plant has been in stalk at the time of its being gathered, and if it have, the root should be rejected. 'Tis only in perfection when preparing to shoot a stem : and whoever will gather it at that time, will find this kingdom affords drugs equal to those of the warmest climates.

Dr. CONYERS.

C H A P. VI.

Farther Trials of the two Roots.

VALERIAN root is sometimes altered a little in colour, from the foulness left about it at the time of gathering ; or from ill management in drying. In this case, let some of it be put into cold water, and stand twenty-four hours. This never fails to distinguish the water from the heath kind ; for the Water Valerian root becomes yellower, as it swells ; and the other gets more of the olive brown than it had while dry.

The scent of the two roots also distinguishes them ; if they have not lain together. The true is fragrant, though with a mixture of the foetid kind ; the other absolutely stinks, and has scarce any thing of the aromatick scent.

Cats, who have much more distinguishing organs of smell than we, perceive this. There are certain scents which affect them, and they are principally of the foetid kind ; though this is not without exception : they will busy themselves extremely about the Water Valerian root ; but shew little regard to the other.

C H A P. VII.

Of gathering the Root.

THESE are the characters by which the true Heath Valerian is to be known from the false ; which is usually sold under its name. When

When a parcel of the right kind is purchased, before it is used, it should be picked and cleaned : those roots which shew they have borne a stalk, should be rejected ; and the runners, or jointed and light strings must be separated from the true fibres. Thus the druggist may be sure he sells what the doctor prescribes : but there still may remain a doubt about its value. The high flavour of the Valerian root is lost in keeping ; and the virtue in great part goes with it.

This root should never be used when it has been long kept ; and the seller's word is not to be taken on this account, for he is always interested to call the old new.

Under these disadvantages, to which the purchase of Valerian is subjected on all hands, nothing can be so rational as the patient's collecting it for himself. Where that cannot be done, let him be guided by the same rules in the purchase, that he would observe in collecting it : let him buy it fresh ; at a right season of the year ; and in the perfect state and condition : this he will know by the following rules.

Roots possess their virtues in greatest perfection when they are ready for shooting up a stalk, but have not yet made the effort : 'till that time they are imperfect, because they have not obtained their full maturity ; and after that they are exhausted. The ultimate end of nature in the growth of plants, is the formation of the seeds : when these are perfected the root is no longer useful, it becomes a stick :
and

and while the stalk is in its growth, the rich juices are sent up so fast to it, that the root is in great part drained of them. Therefore, neither when the plant is in flower, nor when it is about to flower, should its root be gathered for medicinal purposes. While it has only the radical leaves it may : but the best time of all is just when the bud of the stalk is forming.

The growth of the Valerian is this. In July it flowers ; in August the seeds are ripe ; and the winds carrying them off, they strike root. The rains of autumn favour this ; and a small cluster of leaves is formed : these, with the root, continue growing till the severest frosts ; or in mild winters through the whole season.

About the time when the seeds fall, those runners before-mentioned, rising from the head of the old roots, spread themselves just under the surface, or sometimes upon it ; and, taking root, they also form new plants. Each shoots up a cluster of leaves, and sends fibres into the earth, just as the seedlings.

Among the roots we find at druggists, some are large and light ; others small and more firm : the large ones are usually such as have been pulled up by the stalk, at, or after the time of flowering, which are therefore in a great degree exhausted : the small ones are the roots of seedling plants, and of those propagated by the runners, which have been taken up late in autumn, or early in spring : and these having been in their earliest state of growth, have not
their

their full virtue. This is the condition of the single roots brought to sale ; and in the clusters of them, there is the greatest uncertainty : the larger part being exhausted, and often rotten ; and the rest imperfect.

The true season for gathering Valerian is the middle of May, and the finest roots are those of seedling plants. These are known by standing single ; those from runners being always near old roots. These seedlings have had the autumn and winter for taking their first growth. The warmth and moisture of spring have now given them their full bigness, and the rudiment is new formed, which is to shoot up into a stalk. The root is full of its richest juice : and that is the proper season for gathering it.

In the system of vegetation, this is an universal truth : the root which has produced a stalk, and ripened flowers and seeds becomes an absolute chip ; and has neither medicinal qualities, nor any other value. The purpose of nature is answered, and the whole plant usually dies. The MUSA will live a century if it does not flower ; but when it has once bloom'd no art can preserve it from immediate decay. The MOUNTAIN PALM, will live thirty or forty years barren ; but if it flowers it instantly perishes ; and the TREE LAVATERA, which bears our winters even for many years, till it blows, dies as soon as that is over. Even annuals, by preventing their flowering, may be kept alive thro' winter.

In bulbous plants the root decays visibly ;
and

and in the fibrous it has the same fate, though less observed. The carrot which has run to seed, is an insipid stick : and in the potatoe, though fresh roots are produced abundantly, that which was put into the ground in spring, and which has borne the summer stalk is useless.

The gardener thinks he takes up in July the same bulb of the tulip, which he planted the last November; but he deceives himself. That which he sets in autumn furnishes the flower in the succeeding summer; and, as it feeds the stalk, decays. Another bulb is formed during this time, which contains the rudiment of the next year's flower: this encreases as the other withers; and having attained its full growth by the middle of summer, the gardener takes it up, and supposes it to be the same he planted.

What we call a bulbous root is nothing more than a covering of the rudiment of the plant; like the bud upon a tree: and the coats of the bulb, like the films which compose that bud, when they have performed their office decay, and are renewed no more. The rudiment of the Valerian plant is a bud in the centre of the head of the root; of the same kind with the other two: and the root itself has the like fate. It naturally perishes in the winter, when the plant has perfected its seeds; and others are formed round about it, which supply its place.

All this is transacted in the bosom of the earth, and at a time when roots are never taken up by the judicious: therefore it is little seen: but it is the absolute course of nature. The off-sets of bulbs, and the encreased parts of
fibrous

fibrous roots, which the gardener separates in parting them at autumn, are all formed in this manner; containing the rudiments of other plants, and supplying the place of the old ones which decayed in flowering.

It is necessary so much should be known, to direct us in the proper gathering of roots; and thus the philosophy of plants may serve the purposes of medicine.

C H A P. VIII.

The manner of curing Valerian Root.

VALERIAN is in its greatest perfection when fresh dried: but the curing of medicinal roots, is a subject we do not rightly manage in England. The *Ginseng* of the East-Indies, and the *Salep* of the Turks, are instances that others have an art unknown to us.

We cannot preserve any root as they do *Ginseng*; and with regard to *Salep*, our own *Orchis* would perfectly answer its purpose, if we had the same method of curing it. This is not so difficult as may be thought; but it would be wandering from the present purpose, to speak farther of the matter here.

When the Valerian roots are gathered, let the dirt be shook from them, but not by striking them against hard substances. It will separate with little violence; and they must neither be bruised nor washed. Let the leaves and runners be cut off clean without wounding the head of the root, and then lay the whole

D parcel

parcel in a heap in a dry place, where the sun does not come : cover them with a blanket, and leave them thus three days : then string them up on long threads at ten inches distance root from root, and hang these threads across an airy room.

When they are perfectly dry, put them up in boxes, pressing them close together, and cover them carefully.

If any think laying the fresh root in heaps, before it is hung up to dry, a strange practice, they may be reminded of the custom in regard to fruits, whether intended for keeping, or for wine. Those who understand their management, always give them a sweating of this kind, for heightening their flavour, and improving their natural qualities.

The gardener lays his pears in a heap, and covers them with flannel, before he spreads them to keep for winter: and in the cyder countries, apples are treated in the same manner before pressing; and in the vineyards, grapes.

A slight fermentation is thus brought on by the warmth of the substances; and their flavour and virtues are exalted and improved. I don't know that the same practice has been applied to roots before, but the effect is similar; and those who have not been accustomed to Valerian otherwise than as seen in the shops, would scarce suppose this the same medicine: it is highly aromattick, quick, and pungent on the tongue, and the peculiar flavour in it, which we call foetid, scarce deserves so coarse a name.

The root of Heath Valerian in this state possesses all the virtues which have been ascribed to it by authors. It is a sovereign medicine in nervous disorders ; and in particular exceeds all the remedies commonly used against that worst of head-achs, which arises from attention.

It has alone cured epilepsies : and of late has been used very successfully in hysterical complaints ; and in that terrible disorder the convulsive asthma : It alleviates pain in the manner of the more gentle opiates ; and is found highly effectual in fits proceeding from the obstructions of the menses ; not only taking off the symptoms but removing the cause. Perhaps this root may be found, on experience, one of the best of our emmenagogues ; and I would request those who have more opportunities, to try it farther in that intention.

A very large dose of the fresh root will purge ; but this is its least useful quality. I have ordered it lately in that troublesome disease the nightmare ; and in two instances, wherein I have had fair opportunities to try its virtue, have found it a perfect cure.

A very good method of taking it is fresh dried in the way of tea, a dram of the root for a dose, with half a pint of boiling water ; sweetened, and softened with a little milk : but of all the preparations, a tincture fully saturated with the ingredient is the best. The root possesses its full virtue only when it is fresh dried, after it has been taken up at the season just named. At that time of the year it is excellent in powder, or in

the tea-infusion ; but no method of keeping will preserve it long in the same perfect state. therefore the best recourse is to this form : and proof spirit is capable of receiving so strong a tincture from it, that a small dose will have great virtue. I have this year obtained from different parts of England a large quantity of the true root, and have found that an excellent tincture may be made from it in the following proportions.

Cut a pound and four ounces of the root just dried into small pieces, and bruise it in a mortar ; put this into a gallon of proof-spirit ; let it stand four days, shaking it every day ; then strain off the liquor, pressing it hard. Put to this a pound of the root, bruised as before, and let it stand a week : after that strain and filter the tincture. A table spoonfull is a dose. It should be taken in a small glass of water, or of mountain wine once or twice a day.

I have made a quantity in this manner, which is at the service of my friends, or of the faculty ; the rest of the root I have given to Mr. Tomson, a very worthy young man, who proposes to make it for the publick.

One farther improvement it is proper I name here, though sufficient experience has not yet confirmed me in its full use : this is an ACID TINCTURE OF VALERIAN. I have made this by adding two ounces of oil of vitriol to a pint of the preceding tincture, and have found it excellent : the acid exalts the flavour of the Valerian, and this tincture strengthens the stomach, creates an appetite and always prevents that disorder

der of the head, to which nervous persons are subject after eating. The dose of the Valerian being in this form limited by the acid, the plain tincture may be also taken at other times,

The roots sold by druggists differ extremely in colour, taste, smell, and qualities ; as they have been gathered in more or less favourable situations and soils : the difference between the false and true, is that the one has grown in barren and dry ground ; and the other in wet and muddy ; and in consequence there are as many degrees of excellence or defect in the drug, as there are of soils between those two.

There are several parts of England, where the true kind is to be had in plenty. On the great heath called Hind-Head, in the road to Portsmouth, I have seen a vast quantity of it ; and Ray names it upon sufficient authority near Ashwood, by the Buxton-wells, in Derbyshire ; at Parnham, between Brindale and Orford, in Suffolk, and on Ilford Common.

The chief places whence the roots are brought to London for sale are four ; the neighbourhood of Cambridge, the forest of Dean in Gloucestershire, Oxford, and the near part of Kent. The Cambridge and Kentish Valerian generally have a mixture of good and bad ; for they pull up some from the heaths and high grounds, which they mix among the water kind : what I have seen from about Oxford, has more of the Water Valerian ; and from the forest of Dean comes the purest and best our druggists have : but this, like the rest, though the kind be better, is commonly taken up at a wrong season.

'Tis

'Tis said none is imported : but I have found among parcels of Valerian some roots of a kind differing in colour from almost any of the English sorts; and also the tuberous white roots of the *nardus montana radice olivari*, which is a Valerian, not native of this kingdom; therefore those parcels of the drug probably came from France, and could not but be worse for the keeping. It does not appear that any part of the world produces this drug in greater perfection than our own country, provided the soil and situation be proper.

That soil, and situation, can make so considerable a difference in the virtues of plants, appears from various instances in nature; and as plainly from the effects of culture. Lavender and other aromatick herbs, are sweeter, and fuller of virtue in those kingdoms where they grow wild, than with us who raise them only in gardens; and many which we have wild in common with the south of France, are yet greatly superior in their qualities there.

Culture renders the common garden plants larger and more succulent; but it takes off their taste and qualities: and the difference between the Heath and Water Valerian is very like that of a wild and garden herb; the situation in the muddy bank of a ditch, giving abundant moisture, and nourishment.

We see the same plant is more richly flavoured when it grows in a dry soil, and more insipid when in wet; and we find the highest aromaticks are natives of dry and
warm

warm land: indeed to know the effect of abundant moisture and rich earth, we need look no farther than the common lettuce. In the wild state, wherein it lives on dry, parched, and barren ground, its juice is acrid and bitter, and its virtue highly narcotick; so much as to have obtained it the name of poisonous: in gardens where it has rich mould, and abundant moisture, it becomes mild, pleasant, and innocent. Nor does the form differ less: when wild the stalk is woody, and the leaves are prickly: when cultivated the stem is tender, and the leaves are unarmed. So the austere crab of the common, becomes the mellow apple of the orchard; and the bitter almond sweet.

The case is the same in all these instances; the virtues or the qualities of the herb, root, or fruit, depend upon the natural and moderate quantity of juices elaborated, undisturbed in its vessels; and well concocted by the sun. This gives the taste, scent, flavour, and medicinal qualities. When nature throws its seeds in a rich wet soil, or human industry removes them to the garden, the character of the plant is altered, the effective particles are debased or drowned in the additional quantity of juice, and the whole becomes in the end tasteless, scentless, inefficacious, and insipid.

On these principles the culture of the Valerian in gardens must never be attempted; and in its wild state so much depends upon the nature of the soil and season of the year, that it is happy the characters of excellence and
 imperfection

imperfection are marked so strongly on the root itself.

Those who neglect to observe them will be disappointed in their expectations from this drug, though in reality it possesses all the virtue that has been ascribed to it ; and deserves more commendation than has been given it even by its warmest advocates.

T H E E N D.



Directions for placing the PLATES.

PLATE I. to face page 4.

PLATE II. to face page 6.



A N
A C C O U N T
O F T H E
M U S H R O O M - S T O N E .

Illustrated with F I G U R E S .

[Price One Shilling and Sixpence.]



A N
A C C O U N T
O F A
S T O N E,
I N T H E

Possession of the RIGHT HONOURABLE
the EARL of STAFFORD ;

Which on being WATERED

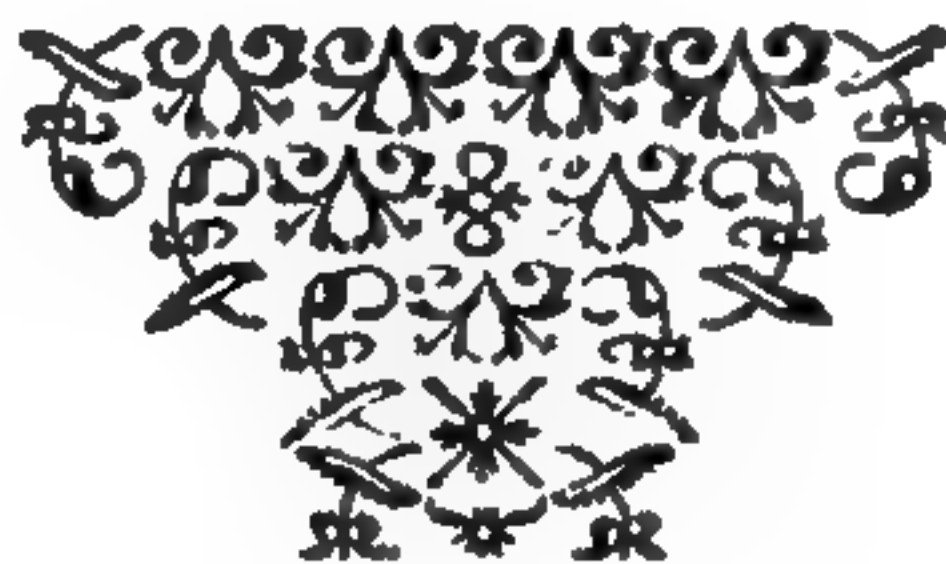
PRODUCES EXCELLENT MUSHROOMS.

With the HISTORY of the

IOLITHOS, OR VIOLET-STONE
OF THE GERMANS.

By J O H N H I L L, M. D.

Illustrated with FIGURES.




L O N D O N:
Printed for R. BALDWIN in Paternoster-row.
M DCC LVIII.



TO THE
RIGHT HONOURABLE
THE
EARL OF STAFFORD.

MY LORD,

 F there be any addition to
the knowledge of nature in
the observations which the
following sheets contain, 'tis fit that I
acknowledge the world owes them
to your Lordship, who gave me
opportunities of making the experi-
ments.

DUTY

DUTY, as well as inclination, enjoin me therefore to lay the treatise at your Lordship's feet: nor can I suppose, you will consider, as unworthy of your notice, the least enquiries into the bosom of nature; since they are to the glory of that Almighty power whom your Lordship's heart adores with more than common reverence; and whose greatness, will be always the more distinctly seen the better his works are understood.

It were easy to exhaust the whole store of dedicatory eloquence in an address to your Lordship: for, to name the STAFFORDS, and the HOWARDS, your great Ancestors,

stors, were to sum up all that is most ancient and most noble ; but neither does your Lordship's ear desire this tribute ; nor have I the heart, or the designs, of those who offer it. If I should praise your Lordship, it would be on another score ; your virtue, and your piety : and I must be permitted to say, that if I may judge the thoughts of others by my own, your Lordship is of all men the most to be envied ; passing the autumn of Life in honourable ease, removed from all connections with a bad world, but that of doing good to the wretched ; and enjoying that superior happiness, which rises from true goodness.

MAY

MAY it continue long !

I HAVE the honour to be with the
greatest deference and respect,

My LORD,

Your LORDSHIP's most

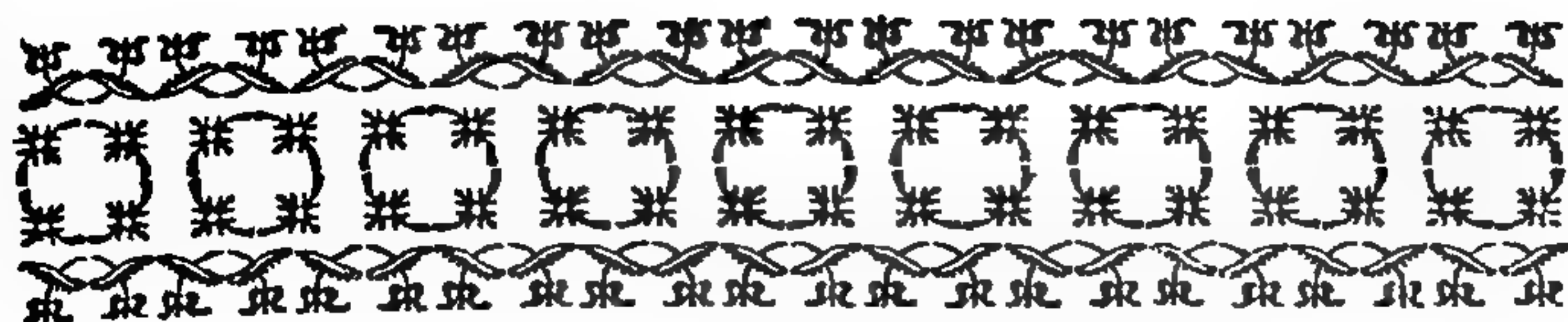
obedient, and most

humble Servant,

PALL-MALL,
August 18, 1758.

J. HILL.


A N



A N
A C C O U N T
O F T H E
M U S H R O O M - S T O N E.



I N T R O D U C T I O N.

HE Italian naturalists mention a stone which on being wetted produces mushrooms; and from their writings an account of it has passed into those of other nations, under the names of LAPIS FUNGIFER, and the MUSHROOM-STONE. Some who have been in Italy have also seen it; and we have been surprised with their accounts of its effects: but as these have not been regarded with sufficient accuracy, nor the substance itself perfectly understood, it may not be disagreeable to the curious to receive a plain account of

B

the

the stone and its productions from one of them now in England, which fully answers what has been related of those in Italy.

THE COUNTESS OF STAFFORD, in whose possession it is at this time, has given me opportunities of examining the course of its productions; and valuing a discovery of the truth, more than even the curiosity itself, has permitted me to make experiments upon it with all possible freedom.


WITH these advantages I have endeavoured to find the true nature of the substance; and hitherto without injuring the specimen itself: the vegetable principle is so strong in the stone that it has perfectly recovered the rough treatment which has been necessarily given it in the course of this enquiry; and probably will continue to yield its valuable growth many years.





C H A P. I.

OF THE NATURE OF THE STONE.


 HE Italians describe the Lapis fungifer as a coarse and loose kind of stone: they say, that it retains always the quality of affording mushrooms when watered: and that the substance now in possession of lady STAFFORD is the same they mean, is evident from its appearance, construction, and qualities. It is a hard heavy mass, of an irregular shape, and granulated surface, like shagreen leather; in colour brown with a tinge of reddish, and very difficultly broken. This is its appearance in the mass when dry. The piece of it now in England is fourteen inches in diameter: when broken it appears rough and gritty, full of small glittering particles, some black, others white, like grains of different coloured sand; and among them are some flakey substances of the nature of the foliated talcs. These are connected together by a brownish matter, with streaks of white; and the whole mass has, when fresh

B 2

broken,

broken, somewhat of the appearance of those coarse granites, which we call, from the place where they are found, Guernsey pebbles, and with which the streets of London are paved. If a knife be hastily drawn over this it yields sparks of fire ; and tho' it has not nearly the hardness of the stones whose construction it resembles, yet the smallest particle of it is not easily broken.

ON putting a piece of it into hot water innumerable air-bubbles rise from all parts of it, like small round bladders. After some time the substance swells a little, but looses nothing of its form ; and if there have been upon the piece thus used, any part of the original surface of the mass, 'tis easy to perceive by the naked eye, that it is covered with a kind of skin, or coat. The mass, when kept under ground, and often watered, becomes softer, but it never moulders away ; nor do the pieces thus soaked in hot water ever crumble or fall asunder, like earthy substances.

THE strongest acids, even aqua fortis, makes not the least impression upon it. It
 lies

lies in them unaltered as in water, only sending up a few air-bubbles.

A **STRONG** fire consumes a part of the mass; and leaves the rest in form of a loose various coloured sand.

THESE are the experiments by which stones are usually tried; and by these the present substance appears to be a congeries of crystalline and talky particles. But as part of the mass burns away, that is plainly not of a stony nature; and its smell while burning shews that it is not bituminous: we are therefore to look for it in the vegetable kingdom; and from this part alone we shall find the mushrooms produced from the stone arise.

On examining a piece of it fresh broken with an attentive eye, the surface resembles in miniature that of a piece of the **PUDDEN-STONE** when roughly broken. There stand out in many parts small tubercles or grains of the gritty matter, some white, some black, some crystalline, and others talky; and between and among these are little hollows, out which other pieces have fallen.

WHAT

WHAT the unassisted eye thus discovers, a microscope perfectly explains to us. On looking over the various parts of such a piece of stone, we find the original surface covered with a thin coat. Pebbles have their crust; and many kinds of stone their coats, of a different colour from the rest of the substance; but these are flinty. On the other hand, the kind of stony masses which this resembles have naturally no coat or crust; and this covering which for that reason only we might reasonably judge to be adventitious, is not of a stony but a fungous nature. It coats the surface with a thin expanded tough substance, and insinuates itself from the outside inward in thinner plates into all the natural crevices of the stone. As this is composed of a mere loose grit, there are interstices and cavities in every part: the several particles of the stone are so loosely thrown together that there is room for this substance to insinuate itself any where between them; and even to surround them. This it does in course of time, and of consequence the inner part of the stone appears a kind of fungous bed, inclosing a multitude of gritty particles; or as if by any art a
piece

piece of sponge could have all its cavities filled perfectly with stone.

THIS holds the naturally loose particles of the stone firmly together ; and lines the beds or hollows out of which others have fallen.

THIS construction appears still more plainly when we examine a piece of the mass which has lain some time in water ; for the fungous matter swelling with the moisture shews itself thus, yet more distinctly. The coat or outer covering of the stone appears whitish on its inside ; immediately under this we see another expansion of greater thickness, which has a perfect fungous aspect ; and from this we may trace the same substance running in irregular plates in every crevice, and surrounding every particle of the stone.

THIS tough and fungous substance is the perennial root of a peculiar species of mushroom, different from the common kind, and greatly superior to it. To this substance is owing the continual production of the mushrooms ; and as all plants have their proper place of growth, this stone is that of the peculiar

cular mushroom, which we see rise from the root thus spread thro' it. See PLATE I.

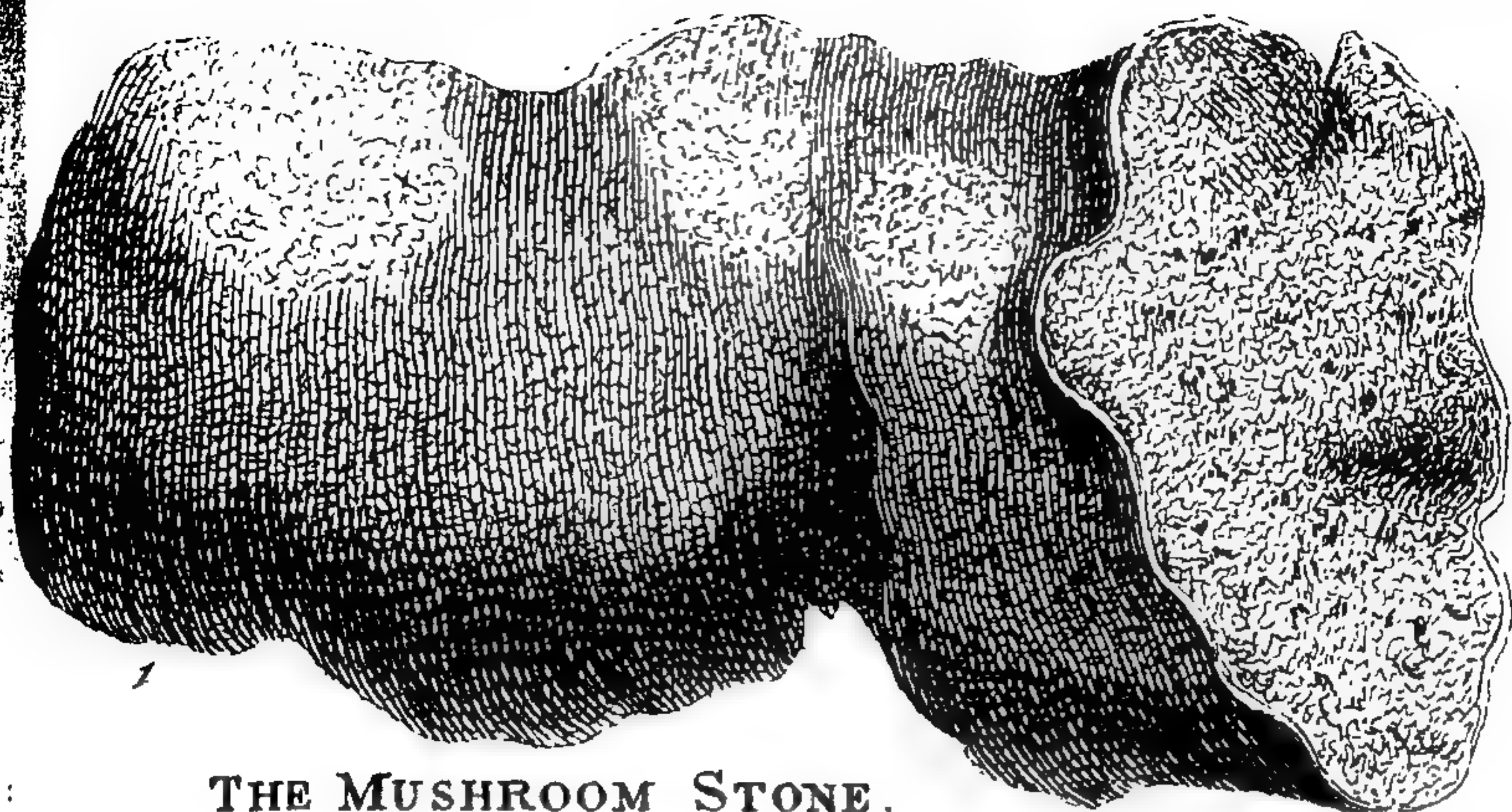


C H A P. II.

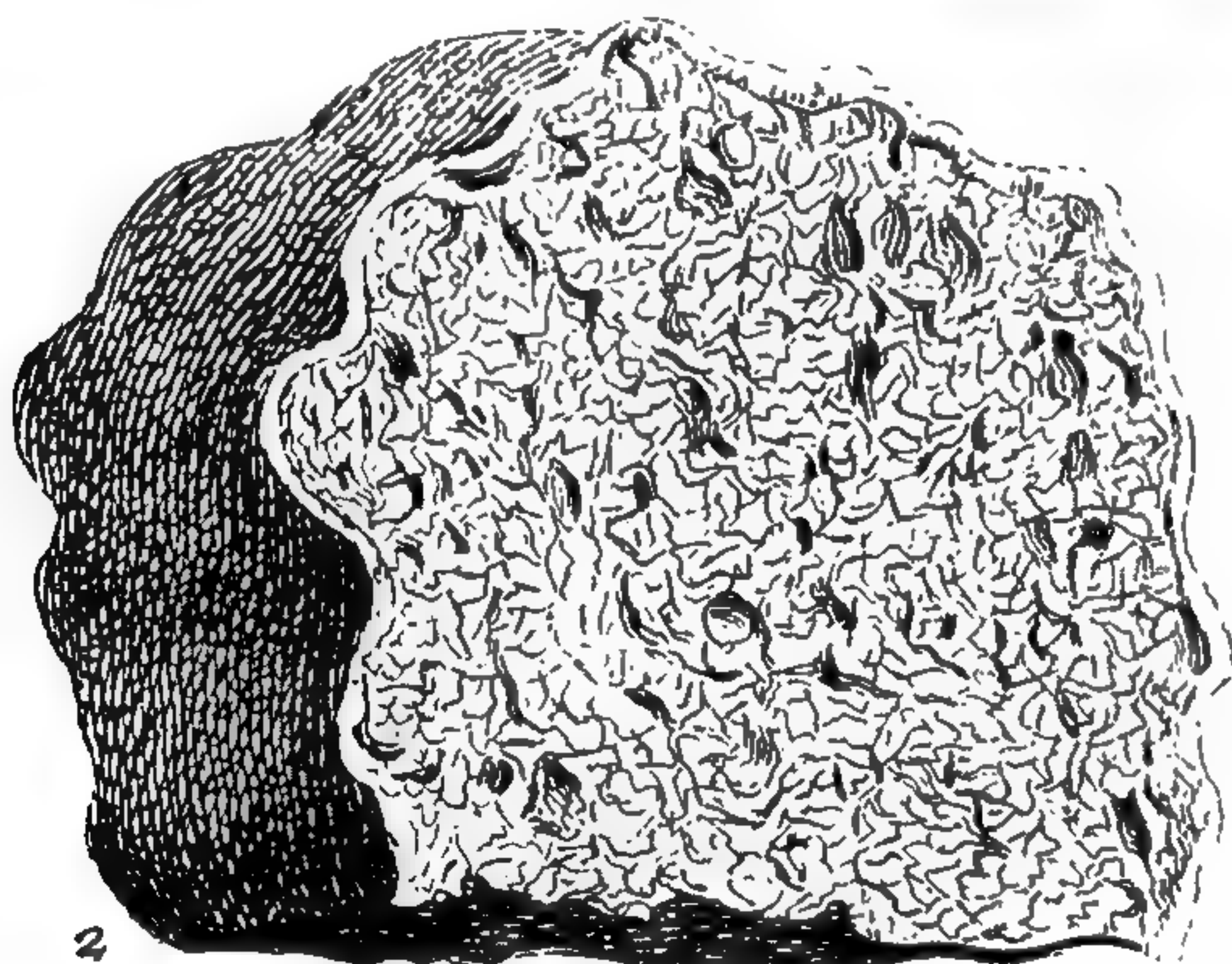
OF THE NATURE OF THE MUSHROOM PRODUCED FROM THIS STONE.

WE know by the preceding experiments distinctly and certainly that the Lapis Fungifer is a stone, composed of crystalline and talky particles, and penetrated every way by the roots of a peculiar mushroom, which are permanent and full of vegetable life, which require this nidus or place of growth, as others do the stumps of trees; and which are ready to shoot up perfect mushrooms by the assistance of moisture.

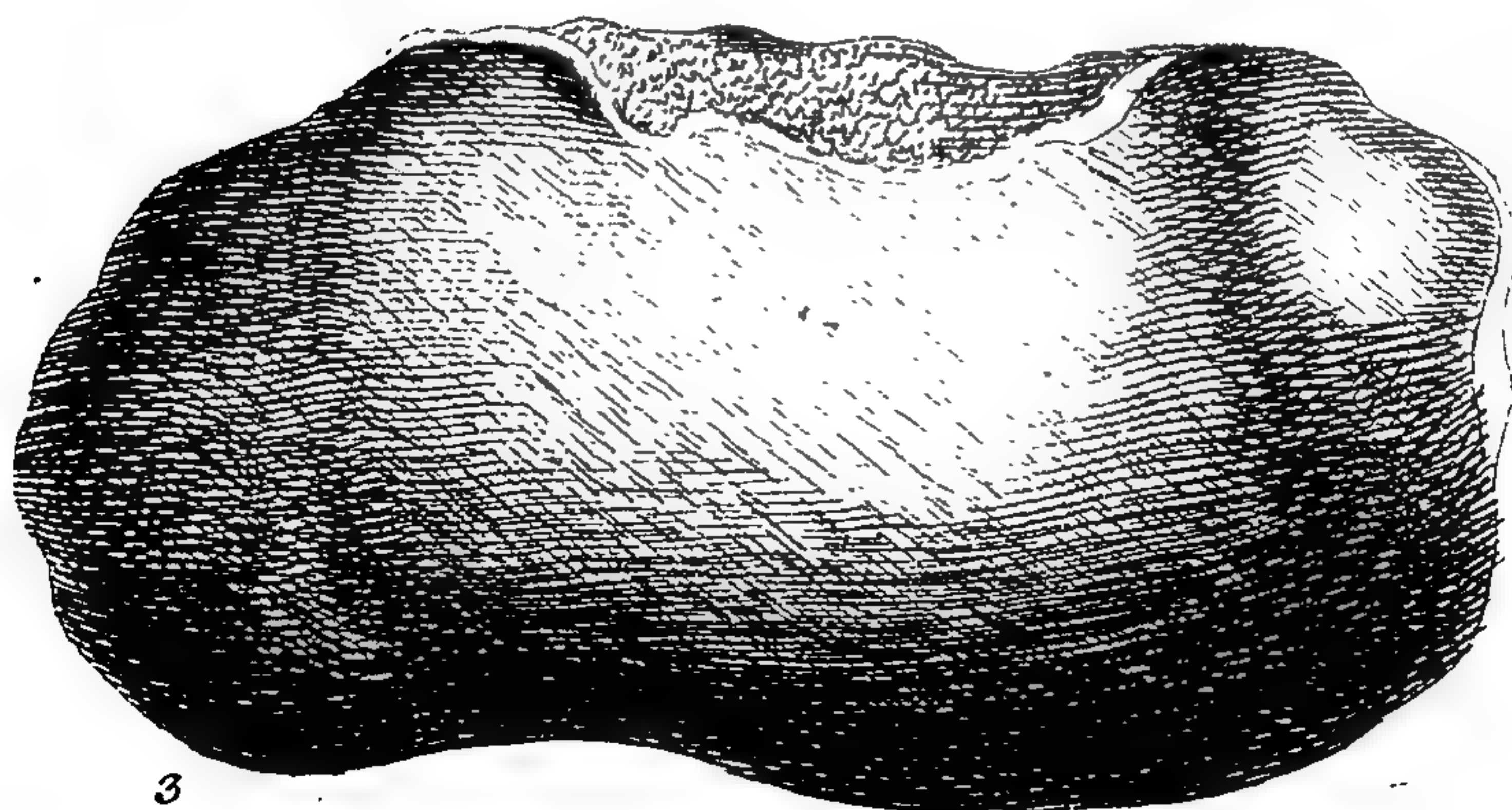
THE name of a mushroom with a perennial root may appear strange to some; but it is not peculiar to this species: several of the Agarics which grow on trees rise from lasting roots, which penetrate the rotten parts of the wood, and in the same manner remain many years.



THE MUSHROOM STONE.



A PIECE of it MAGNIFYD.



THE VIOLET STONE.

years. These rest unseen in the body of the tree during the summer ; but the rains of autumn which easily get at the part where they lie, set the mushrooms to growing. An instance of this shewed itself very conspicuously many years in the wood near THORN-DON in Essex : where every October there appeared upon the trunk of an old ash, in a part where a large limb had been long before torn off by the wind, a cluster of that kind of fungus which Dillenius calls the Liver-agaric, *Agaricus porosus rubens carnosus hepatis facie*. This I several years successively observed, in company with that great ornament of Botany, the late excellent lord PETRE : we found that these mushrooms constantly arose from the same spot ; that when they were decayed there remained always a fungous substance in the place, like the coat of this stone, from whence we could trace numerous broad and flat fibres insinuating themselves into all those interstices of the wood which the decay had made ; and also between the wood and the bark. These roots were in all respects analogous to that fungous substance which runs over the surface, and into

C

the

the cavities of this stone; and like them wanted only moisture to send up perfect mushrooms of their kind. Dr. Vütner has observed the same annual production of agarics from certain spots of trees in the Harts forest in Germany; and Buxbaum in Russia: In London we had for many years an annual fungus of vast size, and of a very peculiar form, from the block of a smith's anvil in the Hay-market; and Tournefort has given a like instance of one on a beam in one of the churches in France, which has, I believe, ever since appeared at the same season.

IF the spots whereon these several mushrooms grew had been examined with sufficient attention, I persuade myself, the same kind of perennial roots would have been found as I have seen in the ash at Thorndon, and in the mushroom-stone: those two are perfectly similar in their nature; and differ only in form; as their productions do in management.

THE root of the ash agaric was flat and stringy; that of the rock-mushroom is irregular

gular and spongy. The ash produces its agarics in autumn when water naturally falls upon the place, or when the damp temperature of the air supplies its office. The rock yields its mushrooms at any time, because it is watered at pleasure.

THE stones which afford these mushrooms are found in the mountainous parts of Italy toward Piedmont ; and also in Sicily and some other places. They lie in irregular masses from one to twenty, thirty, or forty pounds in weight upon the surface, or just covered : many of them only in part buried in the ground ; and some of them, though not all, are covered with this fungous coat.

THOSE which lie wholly on the surface are often irregularly overspread with it ; but they rarely produce any perfect mushrooms. These rise principally from such as are an inch or two within the mould, and they appear to grow out of the earth till they are traced to the root. Those stones which are in part buried and part exposed to the air, often crumble away unless they are covered with
this

this fungous substance ; and in that case the mushrooms usually rise from the part just within the surface.

IF those which lie altogether exposed, and are covered with the imperfect fungous matter, be by any accident, or purposely, covered with mould, there will rise from them perfect mushrooms; and any of the stones thus covered being put into mould, will produce them.



C H A P. III.

OF THE GROWTH OF MUSHROOMS IN GENERAL.

THE course of nature in the production of mushrooms has not been yet sufficiently explained. Linnæus complains with reason, that the want of a due precision in their arrangement is the great opprobrium of the science: perhaps what is seen in this and the other parallel instances, may lead to the better understanding them.

THAT

THAT mushrooms produce seeds is now well known ; and they are in this peculiar species very conspicuous. From those seeds other mushrooms are produced, as in all plants ; and there is the same distinction among mushrooms as other vegetables, some being annual, and others having perennial roots. As among plants, some will live only on a dry, and others on a moist soil ; some on clay, some in water, and others among gravel ; so among the mushrooms each has its appropriated bed, out of which it will not grow ; and even upon which it will not arrive at perfection without a concurrence of other circumstances.

THE annual mushrooms rise, and when they have perfected their seeds perish like annual plants : no part of them remaining but the seed which retains the principle of life to the next season. The perennial rooted mushrooms rise in the same manner from seeds, and perfect seeds again : the mushroom then fades, but the root remains and grows, as is the case in the perennial plants. The first is obvious in many instances ; and may be seen distinctly in every pasture ground in autumn.

BUT

BUT tho' there are certain mushrooms of the earth which have also lasting roots; this is principally the case with those which grow on stones and trees: and the reason is plain. It is but by mere chance a seed of a proper kind of mushroom can be brought into such a place; and nature therefore gives the plant a lasting principle of life that it may continue there.

THE seeds of mushrooms are very small and light; they are produced in vast numbers; and they become the sport of winds: they float in the air like those atoms we see in a ray of light received into a dark room; and millions perish for one which falls upon a proper place for growth.

A COMMON agaric which stands to ripeness upon the trunk of an old tree produces many millions of these minute seeds; which being disengaged from its spongy substance when ripe, ride thus in the air. The greatest part are lost, and often all of them: for none will strike root unless it falls upon a part of a tree where there is rottenness and moisture.

WHEN

WHEN a seed is received into such a place it shoots principally outward; and a mushroom like the other is produced. This may be easily pulled off from the tree ; and there is so little basis or root to be seen, that it appears wonderful how the great bulk was fed. This is the case in the agarics of the first year ; but it is otherwise afterwards : they adhere more firmly : they are difficult to be removed ; and there appears abundant root for their nourishment.

IN the generality of plants raised from seed, the part above ground, and the root increase proportionably to one another ; and it is necessary they should since the root is to supply the nourishment : but it is otherwise in the mushroom kind. They are nourished in a great measure from the air, therefore less root is necessary ; and this part which is small at first, increases afterwards, because its great use is to continue the principle of growth for succeeding productions.

WHEN a new-sown agaric has stood to ripen, and has decayed undisturbed, the root immediately increases. As soon as the seeds
are

are ripe no more nourishment being required to the plant, all is employed there: the fibres enlarge and thicken; they spread out in breadth, and insinuate themselves into every crevice of the wood; and wherever they become exposed to the air, they enlarge into a tough, firm, and irregular mass which bears the injuries of the weather, and at a proper season shoots up new agarics. Such a fungous lump is always produced where the first agaric was rooted, and wherever else the expansions of the root are naked; and in all these places agarics rise the succeeding seasons; as also wherever the coat of bark is cracked or diseased. This I have observed distinctly in two or three species of the true agarics; and probably it will be found the same in all that kind.

IF the variety of nature in the production of other mushrooms be regarded, there will be less cause to wonder at these. Ray names a peculiar kind which never grows but on a dead horse's hoof: the French Memoirs describe another species growing on the bandages of wounds and ulcers in their hospitals: and the Ephemerides of Germany, a
minute

minute kind rising from naked flint : nor is the growth of mistletoe, a perfect plant, from the branch of a living tree, less wonderful. The rudiments of the common mushroom are almost universal on the dung of horses, tho' they will not rise to maturity unless it be covered with earth, and kept moist and warm. The old Greeks say, they may be obtained the same way from the bark of the poplar ; and mouldiness, which consists of mushrooms, is in a manner universal. The difference in size is of little consideration ; for the diminutive mushroom that grows on dead leaves is as perfect as the cart-load agaric of Hungary.

ALL these species owe their origin to seeds of mushrooms of like kind, which are utterly lost when they fall upon substances improper to nourish them ; and when they are received on such bodies as can support them, under certain circumstances, they yet remain in form of roots, or imperfect rudiments till those accidents occur which favour their full growth.

D

It

It is no otherwise in this mushroom of the rock, strange as its origin appears : seeds of the IMPERIAL MUSHROOM are received upon it, and like those of the common kind on the dung of horses they form a root ; from which, in the same manner, when it is treated properly, perfect mushrooms will rise. What has given most the air of singularity to this is, that it was not observed mushrooms might have perennial roots : but that is far from being peculiar to any one kind. Many of the mushrooms which we see in woods, and which seem to rise from the ground, grow really out of pieces of decayed wood under the surface ; and these having perennial roots spread into the crevices of that dead wood, the same logs in those circumstances always produce them. While this dead wood lies on the ground, the seeds adhere to it, and spread their roots in it ; but they do not grow perfect from it till it is buried.

Wood thus filled with the perennial roots of mushrooms, may, easily, produce them, in the very same manner as the rock. A gentleman now in England assures me, he saw in the possession of Mr. Trent at Rome, a
piece

piece of a root of a tree of the size of an ordinary billet, a present from the princefs of Borghese, which being kept in a cellar and water'd, produced every two or three days a crop of excellent mushrooms. This is a parallel case: the kind of mushroom indeed was not the same, nor was the substance the same wherein the roots were lodged; but the process of nature in their growth is perfectly similar.



C H A P. IV.

OF THE GROWTH OF THE ROCK MUSHROOM.

IN this principle, and in this course, the growth of the rock mushroom may easily be understood. As the proper seat of the agaric is in the cracks of rotting wood, that of the rock mushroom is the cleft or crevice of a stone. One of these ripens upon the Piedmont hills, or elsewhere, where the proper stones are found: its innumerable seeds are scattered in the air, and some of them lodge in the cracks of this stone.

FROM such seed a mushroom like the first is produced; which standing its due time upon the stone decays. Then the root begins to grow ; it spreads over the surface ; it runs into the cracks ; and in fine, it covers the whole externally, and furrounds all the particles within, with a tough spongy substance. This is the proper base of future mushrooms of the same kind ; and is in all respects like the roots of perennial plants whose superficial parts, stalk, leaves, and the rest decay, but whose roots remain ready under proper circumstances to produce those plants again.


THE stones may be carried into other parts of the world ; and with tolerable care the root will remain unhurt, for it is very well defended : in this condition that was brought into England which is now in possession of the noble Lady, who gave me opportunity for these experiments ; and the root being in a state of growth, only a proper management is required to produce the mushrooms.

C H A P.



C H A P. V.

OF THE MANAGEMENT OF THE MUSH-
ROOM-STONE.


 HE mushroom-stone when thus received is to be brought to produce them by a regular covering, and moisture. A box or garden-pot must be provided of a bigness to hold it conveniently, and a hole being made in the bottom and covered with an oyster-shell, about three inches thickness of dry loamy earth is to be put in ; upon this the mushroom-stone must be laid, and some good mould taken from under the turff in a pasture must be poured upon it to cover it an inch and half deep : it is then to be watered according to its bigness: from half a pint to a quart of water is to be allowed every other evening ; and this must be given from a fine garden-pot. From the end of August to the beginning of November it should be kept in the garden in a warm sheltered place ; and also from the beginning of March to the middle of May : and these are the seasons in which

which it will bear the most, and finest mushrooms: during the intermediate months it may be kept in a cellar; and it will there also yield occasionally a great many. The quantity of water must be increased when it produces a large number, and diminished when there are fewer. In cold nights a covering of dry straw should be laid over it; but no dung should ever be brought near it. It is the peculiar quality of these mushrooms not to require it; and they are therefore of a purer as well as a higher flavour than others.

If the mushrooms be covered with a hand-glass while they are taking their growth, they will be the larger; but the open air gives them a better flavour. Their great increase while under cover of a glass is owing to the constant moisture about them; for I have observed they are in a great degree nourished by the air: but the abundant wet debases their value.

THE rock-mushroom is a peculiar kind; and it is constantly this species and no other which the Italian stone produces. It is not covered with gills on the under part, but
pierced

pierced with innumerable little holes of a somewhat angulated form; nor does the head rise to a point in the center, but sinks inward. The common mushroom resembles a hat; but this a faucer or drinking-glass; and its stalk is not exactly in the middle, but nearer to one side. The upper part is of a mixed yellow and olive colour; and the surface is broke in a wild, but beautiful manner, into a resemblance of scales and feathers. The under part is white; and in the pores lie the seeds. The substance of the mushroom within is firm and white as snow; and it is of a delicate and high flavour, and is perfectly wholesome.


ALL mushrooms which are porous underneath belong to the BOLETUS kind, of which there are several species beside this that are esculent: tho' many of the same genus are nauseous; and some poisonous. The rock-mushroom here described, differs from all the kinds hitherto treated of by botanical writers; and may be called, *Boletus stipitatus radice perenni, pileo depresso scabro, poris subangulatis*. The old inhabitants of Italy were well acquainted with its excellence: we learn

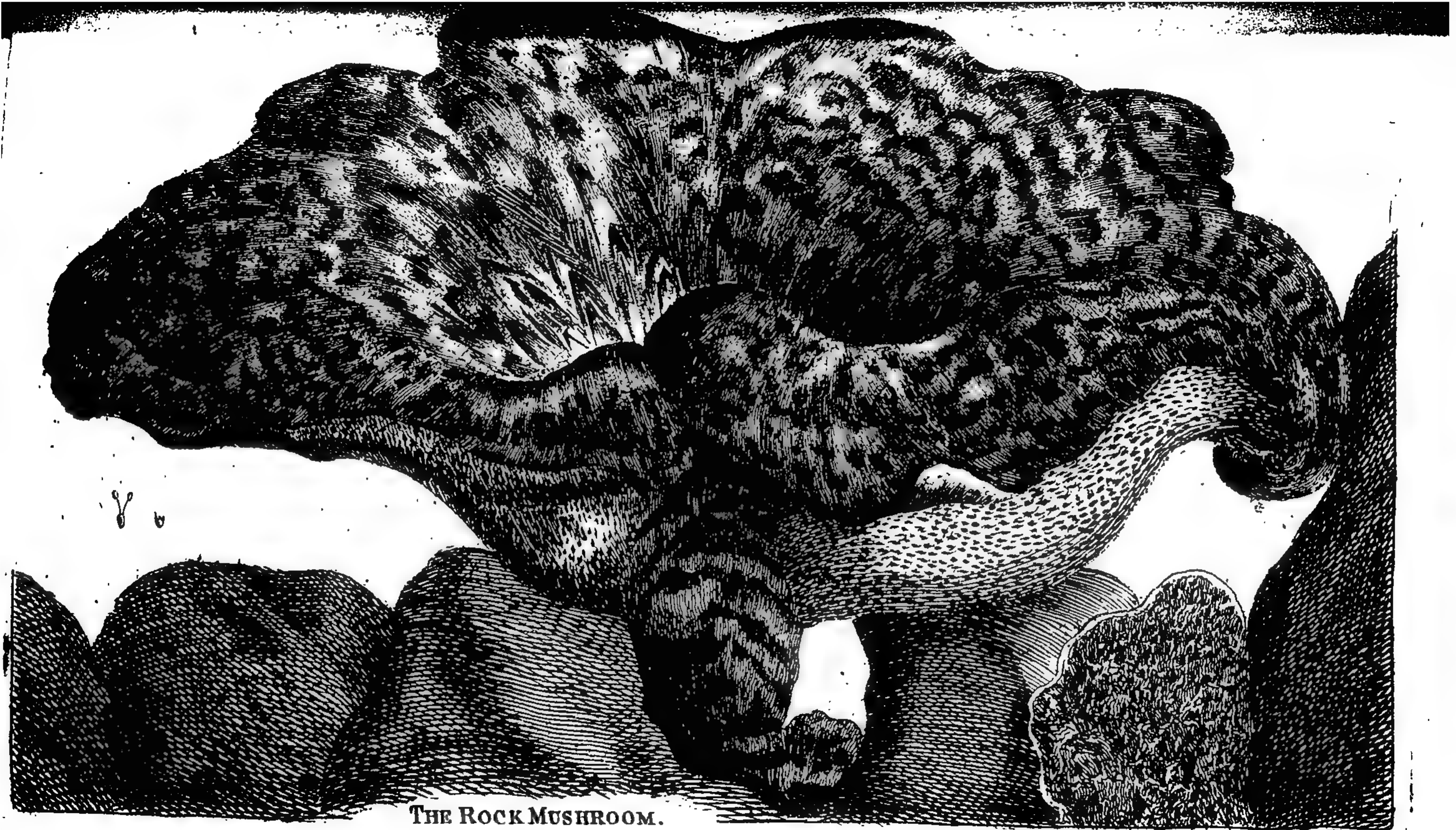
learn from Suetonius that Nero called it *CIBUS DEORUM*, the food of the gods ; and the name *IMPERIAL MUSHROOM*, in the modern Italy, properly belongs to this rock-kind.



C H A P. VI.

OF THE INCREASE OF THE ROCK-MUSHROOM.

 HE first notice I received of the mass, to which we owe the present observations, was on the nineteenth of June last : Lady STAFFORD did me the honour of acquainting me with it that evening. The rock had been some few weeks in her ladyship's possession ; and there was then upon it the shoot of the first mushroom it produced while in that place : this was a thick oblong lump. From that day it continued increasing till the twenty-fourth, at which time I took it up ; and it then measured six inches and a quarter on the head, and weighed one pound and two ounces.



THE ROCK MUSHROOM.

ounces. Lady STAFFORD who had herself observed it during the whole growth, with an attention and accuracy that would have done honour to a philosopher, found by measuring it exactly every four and twenty hours, that it increased pretty regularly at the rate of an inch a day in the length, and nearly the same in the breadth of the head.

ITS form when perfect I have endeavoured to represent in the annexed figure; with its simple and peculiar fructification. See PL. II. A great deal of attention was used in gathering it to see in what manner it rose from the rock. The mould was removed, and its insertion made bare: it rose from the plain surface of the stone by a thick and irregular base, which lengthened into a stalk, and thence proceeded to the expansion of the head. No roots were produced from this stalk in that part under the mould: so that it drew no nourishment from thence; nor were there any roots issuing from it where it adhered to the mass. The mushroom consisted of an expansion of that fungous substance which covered the stone: nothing more. Nor had it

E any

any peculiar fibres : that whole fungous matter served it as a root. The mould which is spread over the rock is useful in our management, and in the state of nature equally, to detain the moisture which is given it : and for no other purpose.

It has been long since discovered, that the gills in common mushrooms contain the seeds ; and in the same manner they are lodged in the pores of this kind. The parts of fructification are like the seed itself, extremely minute, but they are like those of other plants in the essential articles ; and the microscope readily gives us a sight of them.

THE essential parts of impregnation in vegetables are two : the Antheræ, containing a fine dust, in every particle of which is lodged a minute plant * ; and the rudiment of the seed which is to receive it. In the more specious plants these parts are surrounded with gaudy leaves, and there is a style which conveys the minute rudiment to the seed. In many of the smaller plants these appendages

* See Outlines of vegetable generation, Octavo.

and

and ornaments are wanting ; but those essential parts are deficient in none. The antheræ are called the male organs ; the rudiments of seeds the female : in the generality of plants both are contained in the same flower, as in the tulip ; but in some the male organs grow on one part of the plant and the female on another : this is the case in the melon, where the organs of each sex, tho' separate, are surrounded by a flower ; and it is the same in this mushroom, where they are naked.

THE male part consists of two filaments rising from an oval base, and each terminated by its anthera: the female part is a naked rudiment of a seed crowned only with an indented rim, which serves to receive and detain a grain of the powder from the anthera, till it bursts with the wet, and delivers the minute plant enclosed within it to the seed ; where it is lodged safely till it can grow.


BOTH these parts are contained within the pores of the under surface of this mushroom ;

many of them in every pore : and they are best seen in thin sections of that part before the double microscope. The male parts fall off as soon as the antheræ have burst ; but the female remain, adhering to the inner surface of the pores, till the mushroom begins to dry : they then fall off and are scattered by the winds, and all perish except such as fall upon these stones, whose crevices afford them a proper reception.



C H A P. VII.

OF THE VIOLET-STONE.

 T is usual, indeed, that in pursuing one subject of this kind nature opens to us another : and it may not be foreign to the present subject to enter upon an article of natural history, as singular, and hitherto as little understood as this, which the same enquiries may perhaps explain ; and which may be found very intimately connected with it.

THE

THE mushroom-stone has been understood as a body of the mineral kind, and what is called the violet-stone, as another. This last is not so named from its producing violets, but from its having a smell resembling those flowers. The German naturalists have called it *LAPIS VIOLACEUS*, and *LAPIS ODORE VIOLÆ*.

ANY scent in a mineral not bituminous would be strange; and in an absolute stone most of all. The account always appeared strange to me; and I employed the correspondence with which I was favoured in the HARTZ, to enquire into the fact, and transmit me specimens. I received two: one a sparry, and the other a harder stone, whose basis was crystal, both covered on a part of their surface with a coat of a fungous substance, very like that of the rock-mushroom; See PL. I. fig. 3. and in colour reddish. They had at this time no smell; but the account which came with them asserted, that they were fragrant when first taken from the ground. 'Twas evident the stones could not have afforded this scent; for they were of utterly different kinds: and there remained only this coat of vegetable matter

matter to yield it. Micheli and Guettard, Linnæus and Van Rayen, all describe a German moss, a Byffus as they name it, which grows on stones that have been thrown some years out of the mines : Micheli says this has the violet odour ; and Linnæus gives the Jolithus of Schwenkfield as one of its synonyma.

WHAT these authors name a Byffus, and consider as a plant of a different class, I have great reason to believe is the perennial root of the rock-mushroom. If they had met with opportunities of examining the mushroom-stone, such as I have been favoured with, I think they would have found what they call a moss in this instance, to be exactly of the same substance and contexture with the external covering of that mass, which I have ventured to call the perennial mushroom root : nor is the mushroom-stone, destitute of fragrance, tho' it is perceived only occasionally, as it is in what is called the violet-stone. I have observed that at certain times, and particularly in the evenings of hot days, when the stone at lord STAFFORD's has been newly watered, that as I stooped down to the
box

box I perceived a fragrant and aromatic smell. Not imagining the stone possessed this quality, I attributed it to a multitude of pinks which were then in full flower along the sides of an adjoining walk; but a piece of the mass which I cut off, and brought home with me had the same scent strongly for two days. 'Twas evident therefore the fragrance was in the thing itself. Not in the stone, for that's incapable of it, but in the growing root of the mushroom. The smell is a mixture of the violet and the clove-spice; and it went off gradually in the piece I had, as it dried.

THIS agrees with the accounts I received from Germany of what is there called the Violet-stone: for 'tis said, that does not afford the scent at all times; nor all the pieces of it; that it has none when in the mine, and occasionally discloses it on lying in the air. This is abundant proof that the quality is not in the stone itself. The seeds of this mushroom fall on it, and perhaps where the circumstances do not favour for the growth of the perfect fungus, the vegetative power of
the

the seed spends itself wholly in forming this crust. Perhaps also compleat mushrooms of this species may appear on some, tho' the too light attention of the observers does not shew them, they owe their rise to that substance which they have supposed to be itself a perfect plant.

Thus the Violet-stone and Mushroom-stone will probably be found, on more examination, to be no other than two states of the same substance ; and what has appeared so wonderful in their history will be found owing not to the stones themselves, but to a vegetable substance which grows upon them.

THE course of nature in their production appears to be this.

THE seeds of the mushroom here described falling on stones which are kept moist, by being in part immersed in the ground, strike root ; and according to the various, more or less favourable circumstances of the stone, they rise to greater or less perfection. Where all perfectly favours, they produce at once a mushroom like that from whence they sprung,
which

which after having ripened its seeds also, spreads at the root, while the elevated part decays ; and filling the porous substance of the stone, as well as covering its surface, lies for years in this secure place, as the roots of common agaric in a rotten tree ; and is ready upon any occasion that favours, to send up new mushrooms.

WHEN the same seed falls on a stone less favourable to its growth, it is not able to produce a perfect mushroom, but rises only into a coat or crust of a fungous substance : and when there wants on the stone whereon it has fallen both moisture and porosity, it forms even that coat imperfectly : instead of a tough fungous substance it appears dusty or filamentous ; and though it preserves a vegetative life in this state, it never can produce mushrooms.

In all these conditions it is the same substance, and the production of the same seed ;

F

and

and in all of them it has occasionally something of the violet scent.

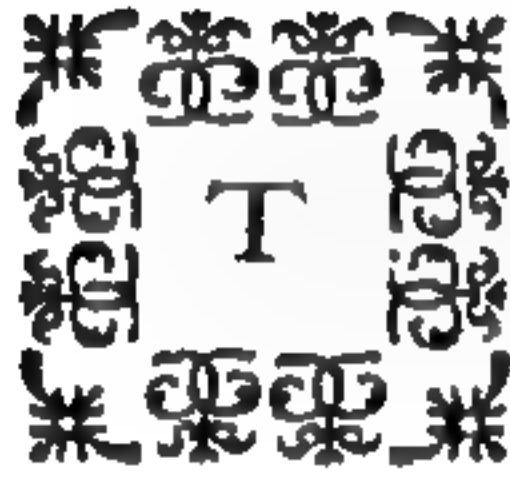
IN the first named state it is called the Mushroom-rock, and in the last the Violet-stone; and there is no wonder that its aspect in that condition has been mistaken by botanists; or the plant itself overlooked wholly by those who studied minerals: it was too inconsiderable for the notice of the one, and too imperfect for the information of the other.





C H A P. VIII.

OF THE VARIOUS APPEARANCES OF THE
MUSHROOM-KIND.


 H A T Fungus's of many kinds as well as this are capable of retaining their vegetative power without their perfect form, is evident from numerous instances. I observed the *fungus spongiosus maximus aqueus* of Dillenius four years in that shapeless condition, upon an old ash-tree near Denham; but the fifth season, on the tree's decaying farther, and more moisture lodging in the part, it sent out three perfect agarics, of that species called by Caspar Bauhine, *fungus angulosus pediculo exiguo* : and in this present year the *fungus tenuis niger ramosus* of Ray, at my own lodgings, shot up four fine plants of the *fungus ramosus niger compressus apicibus albidis* of the same author.

WE have instances of a like nature in other species, upon the credit of Buxbaum, which are beyond dispute ; and farther exact observation, I doubt not, will give more of a like kind in England.

IN all these cases we find, there may be circumstances which will occasion the seed of a mushroom to shoot, and will keep it alive in the condition of an expanded root for many years, without shewing its distinct and proper form : and also that fresh occasions will at any time bring up the perfect plants. Often shelter is wanting : often moisture : and sometimes air : of this there appeared in the year 1756, a particular instance at WESTBOURN-GREEN,

AN agaric of the common great yellow kind grew annually from a wounded part of the stem of an old Elm : a fungous shapeless mass covered the place the rest of the year,
and

and flat roots ran from it between the bark and the wood downward. These had not shot out new agarics, because they were covered ; but some boy in play having driven a large nail a little depth into the tree where these roots ran, the succeeding autumn the rudiment of a new agaric appeared surrounding the nail ; the root having pushed out into growth all about it.

As I lived near the place I had opportunity to observe the progress of this singular vegetation ; a perfect agaric was by degrees formed round about the nail ; and it grew to maturity with the iron in its center

THIS may explain the appearance of common mushrooms with a straw, or blade of grass growing thro' them. It is not that the grass has grown quick ; and pierced them : the straw has no growth : it is that the mushroom has arisen from some part of a permanent root, which having been lodged near the
straw

straw, or the blade of grass has grown round it, and enclosed it.

ALL these instances tend to the same proof: and even the substance which gardeners call the spawn of mushrooms, and which they gather in pastures where they have grown, is no other than an unshaped and permanent part like those we have named; which is ready under the favouring circumstances of heat and moisture, to shoot up perfect mushrooms.

T H E E N D.



A
NEW METHOD
OF PROPAGATING
FRUIT-TREES,
AND
FLOWERING SHRUBS,

From their Parts :

WHEREBY

The common KINDS may be raised more expeditiously ; and several curious EXOTICS increased, which will not take Root from CUTTINGS or LAYERS."

Confirmed by successful and repeated Experience.

By THOMAS BARNES,
Gardener to WILLIAM THOMSON, Esq;
at *Elsham* in *Lincolnshire*.

From Experiments proposed by Dr. HILL.

The THIRD EDITION.

LONDON:

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M.DCC.LXII.

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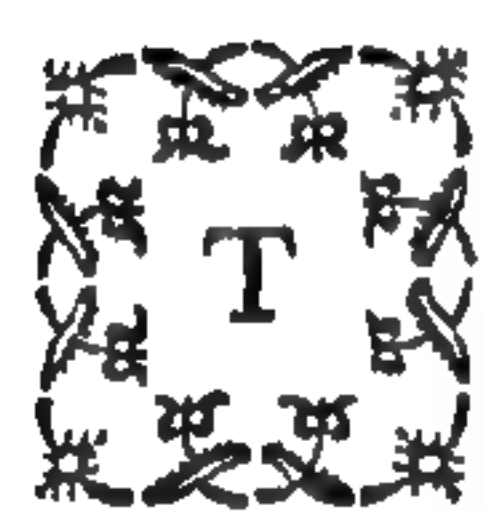
NEW METHOD

Of PROPAGATING

TREES and SHRUBS.

CHAP. I.

The Occasion and Purpose of this Work.



THE difficulty of propagating some shrubs in the common way, and the small increase that can be made from others by the usual methods, brought it into my thoughts to try whether some expeditious manner could not be invented of raising a large number.

EVERY NURSEYMAN will be glad to know this: for if he can, when he has got a new shrub, raise twenty or thirty instead of three or four, it will be a great increase for his profit: and in the same way, a GENTLEMAN, when such a thing falls into his hands, will be better pleased to supply all his friends at once, than a few at a time, and not oblige all under the compass of many years. I thought the thing might be done, and that made me resolve not to be disheartened at one or two trials: and my honoured master has encouraged me, by giving me opportunities to make

the experiments, and looking upon their progress himself.

It is about a year since I began the trials; and between that time and this, I have made them various ways upon four-and-twenty sorts of trees and shrubs of the fruit and flowering kinds; not trusting to one or two samples of each, but using several dozens of every kind, and trying them in all the different conditions of culture, according to their nature, from the stove to the open air. By these means the experiments amounted to many hundreds; and as I kept a constant journal of them all, which I have here faithfully transmitted to the public; every one will see how far each method succeeded, and which deserves the preference.

C H A P. II.

Of PROPAGATION by the BUD.

THE propagation of trees by layers and cuttings, shews, that if a piece of any kind be planted in the ground in such manner that it takes root below, the upper part will soon furnish all the rest, and become a perfect tree. If roots can be thus obtained, the rest follows in the course of nature. But this is not universal; for some trees will not take root in either of these ways: and if they would, still the number is but small that can be obtained by them, because it is but a certain part of the branches a tree can spare for that purpose.

ON examining the cuttings which have failed, I have always found that the mischance happened by the rotting of that part of the cutting which was expected to send forth the roots ; for the danger is where it had been fresh cut, and has no bark to cover it. I thought it natural, that if a method were used to keep that part from decay, all those cuttings would grow, which we usually see fail : and communicating my thoughts to a gentleman of knowledge *, he not only confirmed my opinion by his own, but gave me a receipt for preserving the ends of cuttings from rotting ; and desired me to try it afterwards upon smaller pieces than such as are commonly used ; and upon single buds.

EVERY leaf upon the branch of a tree or shrub, has usually a young bud in its bosom ; and it is certain each of these buds has in it the rudiment of a tree of the same kind : therefore it appeared reasonable to think that every branch might afford as many new plants as there were leaves upon it ; provided it were cut into so many pieces, and this same dressing could prevent the raw ends of each piece from decaying. The advantage of such a practice appeared very plainly, for it must give many plants for one, and the thing seemed so agreeable to reason, that I resolved to try it.

MANY mixtures of resinous substances have been proposed on this head, under the names

of cements and vegetable mummies, by Agricola and others ; but the very best, upon careful and repeated experience, I have found to be that just named, which is made thus :

MELT together, in a large earthen pipkin, two pound and an half of common *pitch*, and half a pound of *turpentine*. When they are melted, put in three quarters of an ounce of powder of *aloes* ; stir them all together ; and then set the matter on fire ; when it has flamed a moment, cover it up close, and it will go out : then melt it well, and fire it again in the same manner. This must be done three times : it must be in the open air, for it would fire a house ; and there must be a cover for the pipkin ready. After it has burnt the last time, melt it again, and put in three ounces of yellow wax shred very thin, and six drams of mastich in powder. Let it all melt together till it is perfectly well mixed ; then strain it through a coarse cloth into a pan, and set it by to cool.

WHEN this is to be used, a piece of it must be broke off, and set over a very gentle fire in a small pipkin : it must stand till it is just soft enough to spread upon the part of the cutting where it is wanted, but it must not be very hot. It is the quality of this dressing to keep out wet entirely. The part which is covered with it, will never decay while there is any principle of life in the rest ; and this being secured, nature will do the business of growing. This I have found true in practice : and by repeated trials, in more kinds than one, I have found



Propagation by the Bud, and by the Branch.

found that I could raise from any piece of a branch, as many good plants as there were leaves upon it.

NOVEMBER the third, 1757, I took off four dozen leaves of the common LAUREL, with the Bud entire in the bosom of each leaf; and every thing being in readiness, I cut the wounded part smooth, whiped it dry, and covered it with some of the dressing. I planted them in four pretty large pots, one dozen in each. The mould in these pots was made extremely fine; and I planted them by making very small openings, and letting in the base of the leaf just so far that the top of the bud might not be wholly excluded from the benefit of the air. I gathered the fine mould carefully about each bud, and pressed it every way close, to keep the bud in its upright position, and prevent the air from coming too easily to the part whence the growth of fibres was to be expected. This was the management of the buds in all the pots.

ONE pot I set up to the rim in garden mould under a warm south wall; another I set in the same manner, but without that shelter; the third I set in the green-house, and the fourth in the stove. The intent of these different places, was to see what effect such variation would take in the growth; the stove naturally inclining all things to shoot sooner.

I gave every one of them the same care and attendance that it was natural to allow to young plants; and no other. They had waterings

waterings in the common course, and those in the open air were sheltered by peas-straw in the severity of the winter.

I examined them JANUARY the fourth. Every bud in the pot which was in the stove had formed a good plant two inches high, and with sufficient roots.

THOSE in the open air were alive, but had made small progress. I examined these last again APRIL the 12th, and almost all of them had made shoots, and had got good root, and were in a fair growing condition.

THESE plants require only the common care afterwards. They are to be removed into a nursery-bed at seven inches high; and they will thus make, by a quick growth, so many handsome shrubs.

THUS I found that as many plants might be obtained as there were buds upon the branch. The experiment may be used to hardy trees of more value; and the benefit of it is very plain.

MARCH 5, 1757, I took off a branch of a white poplar, on which were a great many buds. I cut this into as many pieces as there were buds upon it, cutting the branch through at equal distances between every two buds. I thus had a great many pieces of it, each about an inch in length, with the two ends raw, and with a bud nearly in the middle between them. I smoothed the wounded ends of these, and having some of the dressing ready melted, I wiped them very dry, and spread it all over the cut part of each extremity, leaving the rest of the piece, which was covered

covered with the bark, naked. I planted them in pots in the same manner as the buds of laurel.

APRIL 29, I examined these, and found they had produced so many excellent and healthy plants; every plant was upright, strait, well-looking, and three or four inches high; and they had all very good roots.

It is easy to see how this experiment may be extended; and perhaps there are very few hardy shrubs which will not succeed happily by it. The laws of vegetation are the same, whether the plant come from an English ditch side, or the edge of an American lake; from the hills of one of these countries, or the mountains of the other: nor is there any reason to suppose those from warmer climates will refuse this course of propagation in the stoves wherein we keep them.

If this prove true upon experience, which I have happily found in some late instances, here is a method of increase which may be extended to all trees and shrubs that have buds, and we shall be able to raise much greater numbers, and with much more ease, than by any way that is yet known. It became me to try the experiment itself upon the easiest subjects, and such as were most likely to shew its success: for the enquiry was, whether this could be brought about in nature. Others may assist in the extending the experiments to more kinds: 'tis certain the principles of vegetation allow of it.

AT THE SAME TIME that I prepared these buds of the poplar just named, with the parts of the entire branch, I took off some others with only so much of the wood as was sufficient to keep them entire ; not cutting the branch through, but only taking the buds from the side of it with a small piece of the bark and wood. I smoothed these parts, wiped them dry, covered them with the dressing, and planted them in pots, in the same manner, and with the same care as the others. They had all the same advantages, but the success was not equal. Some of them made very good plants, but others failed : nor were the plants produced from those which succeeded, nearly so fine as those from the others.

FROM THIS OBSERVATION, I lay it down as a rule, so far as these experiments can support a general maxim, that when buds are to be planted, it is best to allow them the whole thickness of the branch, however small the piece may be.

I LAID these pieces horizontally, with the bud uppermost ; and the success was as I have mentioned : it may be worth trying what would be the effect with the pieces planted perpendicular or obliquely, to give the bud a different direction from what it had in my pieces.

MARCH 10, 1757, I took off some healthy branches of the COMMON WILLOW and the WHITE WILLOW : part of these I cut into lengths as the poplar, with one bud in the center of each piece ; and from the other part

I cut out the buds with a piece of the wood to each. I wiped the wounded parts of both dry, covered them with the dressing, and planted them in the same manner as the poplar in all respects.

THE intent of this was to confirm the former experiment by other instances; and as the whole point was to try whether this power was or was not in nature, I again chose subjects the most likely to succeed.

THIS experiment answered exactly as the former: all the buds which had pieces of the entire branches grew; and most of the others. It appeared plainly, that this power of producing trees and shrubs from short pieces of their branches, in each of which there is a bud, is not repugnant to nature, nor limited to one kind: and this shewed farther, that the observation made in the other instance respecting the manner of the operation is true, namely, that the way to succeed best, is not to cut the buds out of the branches, but to cut thro' the branches, and allow each an entire piece, tho' it be ever so short.

THESE were the experiments I made in the last Autumn, and the present Spring, in the propagation of trees by buds; and I invite and request all Gardeners to join with me in prosecuting these trials upon scarce and otherwise valuable kinds.

ALTHO' this practice be new, it is founded in the most plain manner on reason and the nature of things. There is no more wonder that a bud should produce an entire plant,

than that a seed should grow. Each of these contains the rudiment of an entire plant of its kind, and there requires only a proper care in the culture to set it to growing. We do not wonder that the little lumps upon the stalks of the Dentaria, the White Saxifrage, or the Scarlet Lilly, should grow when put into the ground ; and there is the same reason that these buds should, for they contain, in the very same manner, the originals of future perfect plants.

WE do not enough regard the uniformity of nature ; and it is thence our wonder rises. But there is yet another instance in the course of the Gardener's profession, which agrees more exactly with the growth of the bud, than either the seed or the little lump upon the stalk ; this is the common class of bulbous roots. In all these what is called the bulb, is not a root, but a rudiment of a plant surrounded with a great many coats, or a thick substance, by way of defence from the injuries of the air. The roots of the plant are those fibres which grow from its base. The bulb is formed every year, and a new one always succeeds that which had furnished the stalk and flower of the preceding season. A bulb is an embryo plant, covered with films, and fleshy matter, formed under ground upon the base of the root of a plant ; a bud is an embryo shrub or tree, covered with films and scales, in the same manner, and formed in the free air upon the branches of the shrub. They are the very same in their nature and construction ; and in the end they
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are to serve. We see the bulb shoot up a perfect plant, without surprize ; why then should we wonder that the bud will have the same success ? Custom has made the one familiar to us ; the other at present is new ; there is no other difference.

NOTHING could appear so strange as the producing plants from cuttings, when Lauremberg first proposed it to the world, yet what is now more familiar ? The growth of cuttings is of the same nature with this which is here proposed ; and there is reason to believe, that the propagation by single buds will soon be as common : and probably with proper care it will succeed as well in all other trees and shrubs which have buds of a proper kind, as in those here instanced. Many trees and shrubs are destitute of buds entirely ; indeed those from the hotter countries almost without exception ; and in others there are some buds which are destined to the production of some one part of the tree alone, not of the whole : therefore they will not answer the purpose. The Alaternus and the Oleander, the common Syringa, and the Tamarisk, the Savin and the Sensitive Plant, are instances, among many others, of trees and shrubs which have no buds at all, and therefore do not come within this course of propagation. The Alder has buds for leaves, which contain no rudiments of flowers, and therefore perfect plants could not be produced from them. In the poplar there are distinct buds for the flowers, and others for the leaves ; therefore
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if the flower buds were taken, no success could be expected. The Hazel has its buds, containing leaves and female flowers: the Pine and Fir male flowers and leaves together: how these buds would succeed, is a subject of great curiosity, and is worthy trial: but in general, the bud of a tree contains the rudiment of the perfect tree, and therefore a perfect tree may be produced from it.

THIS is the usual condition of buds, and therefore in the generality of kinds, trees may be produced by this practice with great ease, and in great abundance. There is also, as I think, another very considerable advantage from this method, though the limited number of experiments I have named, does not permit me to affirm it with all the certainty of the other facts. This is, that the trees produced from buds will naturally be handsomer and more vigorous than those raised any other way, except from seeds: for in layers there is a great interruption of the course of the juices; and in cuttings it is uncertain whence the principle of growth will begin to act, so that nature is disturbed in her progress, and the juices receive a check in their current, either of those ways; the effect of which in nature, we see plainly in the growth of the Pine-apple, and many such instances: whereas when the bud is planted, the succeeding tree rises straight from its natural place, and there is no turn given to the juices, nor any check in the growing. From the time the rudiment begins to grow, it

it continues growing; and while it lies in the bud, it is as much at rest as the plant in the feed, till nature sets it to shooting. Art does the same in this process, and the effect is no way different; the tree grows just as the shoot would have grown on the branch. So many buds as there are on a tree, so many perfect trees of the same kind may be produced, if the Gardener takes care of them; for each is a young tree, and no other.

AT a certain distance from the root, the rudiments of leaves, instead of forming separate leaves, like those below, coalesce in their origin, and form a cup; and at the same time, and by the same power, whatsoever it is, (for 'tis hidden from us in itself, tho visible in the effects) the rind and pith of the stalk, instead of continuing the growth in that form for the farther increase of the branch, break out into broad thin coloured parts and thready substances, and form the rest of the parts of fructification: a flower is form'd, and seeds follow: that is, the plant ceases to grow in height and length of branches, for nature has given in that respect a certain law to all; and where its parts cease to extend themselves in length, they terminate in the rudiment of a new plant, called a feed.

THIS is the course of natural vegetation. Now art taking its place, produces from the ground that shoot, by planting the bud, which in the common course of things would have been sent from the ends of
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the branches. It would have produced flowers and seeds when it had grown to a very small length in that state, because the height of the stem, and the length of the branch whereon it grew, would have placed it at a due distance from the root: but when it is removed from this situation, and raised by planting the bud immediately in the ground, instead of forming only a short branch, it produces an entire tree, because the rudiments of leaves will never coalesce into a cup, nor will the rind and pith form flowers and seed vessels until the allotted distance from the root is once obtained.

LINNÆUS, who adopts from Loeffling this doctrine of the state of buds, says, He will give a great addition to the science, who shall say what it is that influences the extremities of the plant to burst out into flowers, and to form seeds. If I may offer my humble opinion, it is this: Nature has allotted to every plant, as to every animal, a certain growth or stature which it should not exceed; and the cause of difference in that stature in various plants she placed in their roots.

EVERY root, I imagine, has so much power as is necessary to carry up a plant to a certain height: then it ceases; and therefore there ends the immediate growth of the plant. When the branch can extend no farther, its parts all terminate; not abruptly, for that is not the course of nature in any thing, but each part, according to its kind, terminates in some one of the organs

gans of the flower, and the result of all is a seed ; which being put into the ground will again grow and extend itself, because it gets a new root.

THE plant can grow no higher, because its root can furnish no more force for the ascent of sap ; but the termination of the parts is by a seed, that is a rudiment, which must be put into the ground, and will then get new root, and therefore grow again.

ART, and the practices of the gardener, may interrupt and disturb nature in these operations, and produce vegetable monsters ; but this appears to be her regular course ; and thus it is that a bud, which if it had opened on the tree, would have produced only a short flowering branch, will, like the seed when planted in the ground, grow to the height of the original tree : for the power of the root it gives, is sufficient for that purpose.

A ROOT is required for this, because only the power of that organ can extend and increase the parts ; but nothing more is wanting ; for roots, like the polypes and certain worms, have power even when cut to pieces to reproduce the several parts.

FROM these considerations may be understood all that appears wonderful in the production of plants from the bud, and consequently from their other parts : and we shall see that what appears to be production or propagation, from the parts in general, is the same thing under another form : and that the raising plants by cuttings, is another
C way

way of operating by the bud, though not so regularly. If this be proved, it is certain that the taking a bud itself will be preferable to the setting it loaded with a part of a branch. The rudiment of a root will strike more readily, when the bud wherein it is contained is placed immediately in the ground ; and the course of the sap will be plainer, shorter, and easier, than when it is to run through a long though useless branch. This is in some degree reducing the Gardener's art to its principles ; and we shall always succeed the better, the more perfectly these are understood.

If it be true, according to these remarks, that a bud is nearly of the nature of a seed, there can be no doubt of its succeeding the better, the nearer we bring its management to the seed culture. Indeed there is in nature something like an instance of it in the plant *Bistort*. This produces bulbs upon the stalk, which are a kind of buds ; and these usually fall off, and take root ; but sometimes they will shoot upon the stalk. In the first case they produce perfect plants of the same kind, but in the latter always poor, irregular, and imperfect ones.

C H A P. II.

Of the dressing of cuttings with this cement.

HAVING seen the good effect of this dressing upon the wounded part of these pieces of branches ; that it certainly prevented their

their rotting in the ground, and by that means gave nature time to operate in the upper part of the branch ; I resolved to try its effect upon some cuttings of those tender exotics which are found commonly to fail. It appeared to me, that the only cause of this was the rotting of the lower part of the cutting ; and consequently, that if this dressing could prevent that, it would secure the growth of the shoot.

MR. MILLER, in his Gardener's Dictionary, says, " Some have asserted the coffee-tree would grow from cuttings ; but that in all the different trials he had made, he never could obtain one plant that way." Nobody will doubt this author's experience, or that he knew how to manage his cuttings perfectly well : for this reason I fixed upon the coffee-tree for the kind I should first try in my new way.

NOVEMBER the third, 1757, I took off some cuttings of the coffee-tree in the usual way ; I wiped the wounded part very dry, and dressed it with some of the cement just melted so as to run. I planted these cuttings in pots in the common way, and set the pots up to the rim in the bark bed in the stove.

As this was a point of importance, as well as curiosity, I did not think it just to risk the whole upon one trial ; therefore,

NOVEMBER the 28th, I took off some more cuttings from a coffee-tree, dressed them with the same care, and planted them in the same manner

manner in pots, plunging them into the bark bed in the stove.

APRIL 20, I examined these cuttings, and found they were in a very healthy condition.

MAY 16, I again examined them, and they had shot six inches in height, and had got very good roots.

ON the 12th of DECEMBER I took off some slips of the coffee-tree, wiped the wounded part, and dressed them with cement. I planted these in the same manner as the cuttings, and gave them the same care; they succeeded as well, but not at all better than the cuttings. They all furnished very good and healthy plants.

FROM these experiments it appears, that those tender and precious shrubs and trees, which will not grow in the common way from cuttings, may be brought to succeed in this manner: and this is a very considerable use of the dressing here described. It is a nice and difficult article to hit the right ingredients and just proportions: many have failed in various operations, who used such mixtures as were ill made up; but ours will certainly answer this and the former purposes, as well as many others, to be named hereafter.

THAT this effect of the dressing upon the cuttings of tender plants, might be confirmed or refuted by more instances,

APRIL 17, I took off some cuttings of the orange and lemon trees in the common method used in cuttings: I wiped the raw ends very dry, and dressed them with the cement.

I planted

I planted these in pots, and plunged them in the bark bed in the stove.

MAY 28, I examined them, and found they had began to shoot.

JUNE 20, they had shot three or four inches, and got very good roots.

APRIL 6, to confirm this practice by another instance, I took off some cuttings of the DOUBLE OLEANDER: I wiped the wounded parts, covered them carefully with the dressing, planted them in pots, and plunged them in the bark bed in the stove.

MAY 29, I examined these: they had all done very well; every cutting had shot six inches, and they had all got very good roots.

APRIL 12, 1758, I took off some cuttings of the coffee-tree, wiped the raw part dry, and covered it carefully with the dressing; I then planted them in pots, and plunged them in the bark bed in the stove.

MAY 30, I examined the pots; I found every one of the cuttings had formed a good and thriving plant: they had shot six inches in length, and had got good roots.

THESE experiments shew, that the dressing agrees equally well with the generality of plants, preserving the lower part from decay, and by that means giving nature an uninterrupted course for the nourishment of the shoot above, and time to send out roots from the part below in the same manner; for when nourishment is received, and the vegetable principle is unimpaired, the shooting of roots from the part below the surface, is

is as natural as the sending out of branches from above.

It is plain this use of the dressing may be of great benefit, since it will cause many plants to succeed by cuttings, which would not otherwise do that way at all ; and will make others succeed freely and generally, which without this assistance would answer but seldom, and at the best but poorly. The preventing the decay of the bottom of the cutting is the great article ; for when that rots it destroys the whole. The decay of this is like a mortification in animal bodies, as soon as it has seized the part, it spreads and infects, and destroys all.

THIS decay in cuttings is occasioned by the moisture of the ground which affects the raw parts ; but if that be guarded from the mischief, nature does all the rest. The Gardener need only prevent the decay of the cutting, the growth will follow without his assistance.

BUT though the effect of the dressing for this purpose is general, it is not universal : though it will answer with most plants, it will not do with all. This I have found by the like experiments, and it becomes me to acknowledge it : physicians have done the world as much service by giving accounts of diseases wherein remedies failed, as of those in which they succeeded ; and I would not serve this cause, even by silence, where it failed.

APRIL 19, I tried it on the sensitive plant. I took off some cuttings with great caution,

caution, being sensible how difficult it would be to make them succeed : the pots were ready with excellent mould, and the dressing on the fire ; I wiped the raw ends dry, covered them carefully with the cement, and planting them with all possible care, plunged the pots into the bark bed in the stove. They all died.

WILLING to make another trial, that I might be sure wherein this method failed, as well as where it succeeded, on the 28th of MAY I dressed another parcel of cuttings of the sensitive plant in the same manner, using, if possible, more caution than at first, that they might have every possible advantage. JULY 29, I examined the pots, and these were also all entirely dead.

IN experiments on raising the sensitive plant by cuttings therefore, this method fails ; but it is the only plant on which I have hitherto found it ineffectual.

IT is plain therefore, that the use of this method will be extremely beneficial, not only for the raising plants from buds, but also from cuttings. That strange writer, Agricola, who first proposed this kind of propagation, has disgraced his work by many falsehoods ; and for that reason, what was true and useful in it, was long neglected ; neither had he the secret of a good cement, nor the great advantage of stoves : so that while, on the one hand, he has ventured to assert much more than is true, on the other he had not opportunities of knowing all that could be done by it.

THAT

THAT author has asserted that trees may be produced from leaves. He says, the tender part between the ribs decays, and the fibres grow up into branches: he has even given relations and figures of orange and lemon trees, and many others, which he says he raised in this manner. Though there was little probability of truth in these accounts, yet being upon the subject, I resolved to give this also a fair trial, using on some leaves of each kind the cement he directs, and on others my own. The result will be found in the following chapter.

C H A P. IV.

EXPERIMENTS *on* LEAVES.

NOVEMBER 3, 1757, I picked four dozen healthy leaves of the common laurel: I took them carefully from the tree, with no buds joining to them: I smoothed the end when they were pulled off with a sharp knife, wiped it dry, covered it with the dressing; and thus preparing them all, I planted them in four middle-sized garden-pots, one dozen in each. Two of these were exposed to the air, the one under a south wall, the other without that shelter, and both set up to the rim in mould; a third I set in the green house, and the fourth pot I plunged in the bark bed in the stove. This last place was chosen to promote the shooting of the fibres, nothing having so great power for that purpose.

THAT

THAT the determination of this point might not rest upon one set of experiments made at only one season, APRIL 12, 1758, I took off two dozen more leaves of laurel, with the same precaution: I dressed them in the same manner, and planted them in a shady border.

MAY 29, 1758, I took off a third parcel of laurel leaves, and dressing them as the others, planted them also in a shady border.

AT the same time I examined those of the NOVEMBER planting, and found them all dead in all situations.

APRIL 19, I took off some healthy leaves of orange and lemon trees; cut the raw ends smooth, wiped them dry, covered them with the cement, and planted them with all possible care in pots of good mould, and plunged them in the bark bed in the stove.

FROM time to time I gave these all possible advantages for promoting their growth.

MAY 29, I examined them; they were all dead, without any attempt to shoot out fibres.

MAY 30, I selected another parcel, prepared and planted them with the same care, and gave them all the possible advantages for growth.

JULY 29, I examined them, and found them all dead; no one having made any attempt to shoot out any fibres.

THAT this might not rest upon one species in the stove, I determined to try also the coffee-tree.

APRIL 27, I took off some very fine and fresh leaves from a healthy coffee-tree, smoothed the raw ends, covered them with cement, and planted them in pots. I set these in the bark bed in the stove, gave them all the same advantages with the others, and on searching them, MAY 30, I found them all dead.

DURING the course of this experiment, on the 16th of MAY, I took off another parcel of the coffee-leaves, dressed them with the same care, and planted them in the same manner.

JUNE 27, I examined them, and found them all dead.

ALL this time the laurel-leaves of the several Spring plantations remained in the ground; and I bestowed on them the common care, being determined to omit nothing that might give fair play to the experiment; nor to take up any leaf till it should be evidently dead.

AUGUST 26, 1758, I examined carefully those leaves which had been planted in APRIL, MAY, and JUNE, removing the mould a little from them. It is certain some of them have shot a few fibres from the lower part of the foot-stalk. What will be the result, is impossible to say; the prospect of success is very little; but the question is not fully decided.

Since this I have found by trials at Bayswater that Lady's smock will grow from the leaf, and there are some others.

J. Hill

C H A P. V.

*Of PROPAGATION of TREES by parts of the
ROOTS.*

FROM the success of the method of propagation by small pieces of the branches of trees, it is natural to conceive that smaller or larger pieces of the roots will answer the purpose ; and the same author who has treated of the last experiment, mixing truth with falsehood, has named also this.

REASON is very fairly on the side of the experiment. We see that roots, wherever they reach the surface of the ground, shoot up into young trees ; and we find, by manifold experience and observation, that the difference between roots and branches, is little more in nature, than that the one are buried under ground, the other kept above it. This new method of propagation depends upon one principle, namely, that the rudiments of new plants are lodged in all parts of the old, and are ready to grow from them to perfection, whenever they have proper advantages. Therefore it should appear to reason, that if a piece of a root can be kept from decaying in the earth, it will produce one or more new plants. This I proposed to try by the following experiment :

NOVEMBER 3, 1757, I raised carefully by opening the ground, a large horizontal root of the WILLOW-LEAVED BUCKTHORN. I

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trimmed

trimmed off all the side shoots ; and cutting the two ends smooth, wiped them perfectly dry, and covered them with the dressing all over the raw parts ; not only the two ends, but the several places also from whence I had cut the side shoots and large fibres. I opened a trench in a bed in the nursery long enough to receive the whole piece, and laid it in horizontally, and covered it an inch deep with mould, not raising a ridge over it, but keeping the place on a level with the rest of the bed.

APRIL 12, I examined this ground, and found a great many shoots rising up at different distances from the whole length of the root.

APRIL 30, many of the shoots have got six inches high, and all appear very vigorous.

MAY 20, several of the shoots are a foot long, and promise to make very strong and fine plants.

JUNE 27, I took up the entire root, and cut it into as many pieces as there were good shoots : thus every young plant had a piece of the large root for its base, and a multitude of small fibres newly shot.

I WIPED the two raw ends of every piece, covered them carefully with the dressing, and just trimmed the extremities of the new fibres.

I planted them in a shady border in the nursery, and occasionally watered them. I have so many fine plants. These seemed in danger at the first removal, and I believe it would

would be better hereafter, when plants are thus raised, to let them stand till the next Spring before they are moved.

To try whether the roots of trees would not produce new shoots as well when cut to pieces, as in the entire length,

NOVEMBER 3, the same day with the first experiment, I took up another root of the same shrub, and cut it into pieces of two or three inches in length; I smoothed the raw ends of each piece, took off the side shoots, and covered the two raw ends, and all the small wounds made by taking off the fibres, with the dressing. I planted them, at the same time, with the entire root in the nursery, and gave them the same care. The success was the same.

JUNE the 28th, they had all shot up one or more new plants. I took them up, took off all but the best shoot, and planted them in the nursery, where they are now growing. That this experiment might not rest upon one trial, or seem appropriated only to one plant; on the same day, NOVEMBER 3, 1757, I took up two roots of a Virginian Acacia, which was in good health, and could spare them without danger. One of these I dressed entire, the other I cut into pieces of two or three inches long; and covering all the wounds with the cement, I planted them in the same manner as the others, in an open part of the nursery, laying them lengthwise in a shallow trench, and covering them an inch with mould.

IN frosty weather I threw a little peas-baulm over the ground.

APRIL 24, I examined the ground, and found young plants rising from almost all the small pieces of the root, and a great many from the entire one.

MAY 20, I had from these roots a great many fine plants of a foot or more in height.

JUNE 27, I took up the large root, and cut it into as many pieces as there were good plants; I wiped these dry at the ends, and covering them with cement, planted them out in the nursery. They succeed very well; but required care at first. It will be best to let these plants all stand till the next Spring before they are removed.

To try whether the root would succeed best naked, or with the fibres about it, the same day, NOVEMBER 3, 1757, I planted a root of the Sallow thorn, and another of the Virginian Acacia with their fibres. These are no hindrance, and they appear to me to be an advantage. The great point is securing the root from decaying at the two wounded ends; for if that be prevented perfectly, nature will do all the rest.

THE pressing down the mould about the root when first planted, is a very necessary caution; and in the course of the experiment, the place must be kept moist with due waterings. According to the more or less hardy nature of the shrub the root will require more or less shelter and defence in winter; and with this management there is no doubt of perfect success.

At the same time that I made these experiments on the roots of European and American ornamental shrubs, I was determined to try it also on fruit trees.

NOVEMBER 3, 1757, I took up two long pieces of the spreading roots of an apple-tree, beginning at some distance from the stem; and opening the ground all along, that I might get up the extreme part of the roots, with their small divisions. One of these I cut into lengths, and the other I left entire, not cutting off the side shoots or fibres from either. I smoothed the wounded ends with a sharp knife, and covered them perfectly with the dressing or cement just made warm.

I opened a trench in a bed of the nursery, and laid them in, covering them an inch over the upper part, with mould pressed well down in every part about them. I allowed these the same care as in the former instances, and they succeeded as well.

APRIL 7, 1758, I examined the ground; several young plants appeared both from the entire roots and the pieces.

MAY 20, 1758, many of the new plants had shot a foot high, and were very vigorous and promising.

JULY 27, I took up the entire root, cut it into as many pieces as there were good plants; and wiping their raw ends dry, covered them with cement, and planted them out in the nursery.

THEY prove very good plants.

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THE pieces of the root planted at the same time succeeded also very well ; and having been transplanted into the nursery, are now good plants.

AT the same time, NOVEMBER 3, 1757, I took up two handsome pieces of the root of a pear-tree, and managed them in the same manner exactly as those of the apple-tree in the former instance. They were planted in the same manner, and had the same success. That which had been laid in the ground entire, I cut in JULY into as many pieces as there were good plants upon it, and the others I trimmed of all shoots but one to each. The wounded parts I wiped dry, and covered with cement, and planting them in the nursery with the common care, they are all now thriving plants.

THAT this experiment, which may be useful to Nurserymen, and all who desire to raise a great number of plants, might not rest upon so few kinds, I extended it at the same time to several other trees and shrubs.

NOVEMBER 4, 1757, I cut off some roots of the Elm, the Oak, the Cherry, the Plumb-tree, the common White-thorn, and the Platanus : some of these I planted in the whole lengths, and others in each kind I cut into short pieces, covering with cement the wounded parts, and planting them in the same manner as those before mentioned, and the success was also the same.

APRIL 30, I examined the ground, and found they had all sent up vigorous shoots.

MAY



Propagation by the Root

MAY 26, most of them had shot a foot or more in length, and were very promising. These I treated in the same manner as the preceding; and as many of them as I chose to preserve, are now fine plants.

I AM of opinion, however, in regard of these as well as the others, that if they had been suffered to remain till the next Spring before they were removed, they would have done better, and with less trouble.

C H A P. VI.

Of PROPAGATION by large BRANCHES.

THE same kind of reasoning, which led us to believe that the roots, or pieces of roots, would raise young plants, being very naturally extended to the branches, I was determined to try what would be the success upon experience. The difference between roots and branches being very little, the same method may be used for one as for the other.

NOVEMBER 12, 1757, I took off a branch of an apple-tree, and rubbed away so many of the buds, as to leave them only at three inches distance, or thereabout, and as much as could be all on one side of the branch. I smoothed the end, wiped it dry, and covered it with the cement, as also the places where the buds had been rubbed off. Thus prepared, I laid the branch in a trench opened in the nursery, in a bed of good mould, and covered it an inch, pressing the mould very well about it.

APRIL 27, 1757, I examined the ground, and found a great many very fine plants coming up.

MAY 26, they had shot fix or eight inches, and got good roots.

JUNE 12, the plants being all very vigorous, I took up the branch, cut it into as many length as there were plants, covered both ends with cement, and planted these in a shady bed in the nursery.

JUNE 30, I examined the plants, by removing a little of the mould, and found they had got fresh root. They succeed very well; but probably would have done yet better, if left in the ground with the entire branch till the succeeding spring.

AT the same time that I began these last experiments on the Apple-tree, I tried also the Pear.

NOVEMBER 12, 1757, I cut off a handsome branch of a Pear-tree, rubbed off a part of the buds, and smoothing the wounded end with a sharp knife, I covered it with the cement, as also the places where the buds were rubbed off. I planted this in the same manner as the other, and with the same success.

JUNE 12, I took up the branch, cut it into as many lengths as there were good shoots, and planted them out in the nursery, cementing first the two wounded ends. They are all now living, and are thriving plants.

To extend this experiment to other kinds of shrubs and trees, I made choice of the Sallow Thorn, Elm, and the Virginian Acacia. The
result

result was different, and I shall give it separately.

NOVEMBER 9, 1757, I cut off a branch of the Sallow Thorn, or Sea Buckthorn, rubbed off a part of the buds, smoothed the wounded end with a sharp knife, and covered that part, and the places where the buds had been, with melted cement, I planted this in a trench in the nursery, in a bed of good mould, as the others.

APRIL 7, several very good plants appeared.

MAY 20, I cut the branch into several pieces, each having a good shoot ; and covering the two wounded ends with cement, planted them in another bed. They are all now good and healthy plants.

APRIL 20, 1758, I cut off in the same manner some branches of an elm-tree, and planted them with the same caution in a shady border of the nursery.

JUNE 29, I examined the ground : they had all taken root, and there were a great many good shoots from them.

NOVEMBER 15, 1757, I cut off a good branch of the Virginian Acacia, smoothed off the wounded end, wiped it very dry, and covered it with melted cement. I planted this in the same manner, and with the same care as the other, covering the ground in frosts with peas-haum, and removing it when milder.

APRIL 30, I examined the ground ; nothing was seen coming up ; but on removing a little of the mould, the branch appeared to be alive.

JUNE 2, I examined it again : the branch was quite dead, and there had been no appearance of any shoot from it.

THIS method by the branches of trees, is but a different way of raising by the bud, but we see it is not universal ; though it will succeed with the far greater part of plants. The Gardener may understand by this, that when he would try a new method of any kind whatsoever, he should not limit his experiments to one sort of plants, nor be discouraged at their failing in one species. It is plain, that the same method may be successful in one instance which fails in others.

As to the branches and pieces of branches laid horizontally in the ground, they will thus produce plants of a good kind ; so will at any time pieces of them, cut to a proper length, secured from rotting in the wounded parts, and placed in an erect position.

FEBRUARY 6, 1758, I cut off some shoots of an Apple-tree a foot long, and took a piece of the old wood with them, I smoothed the raw parts, covered them with cement, and planted them in a bed in the nursery, at six inches distance, leaving only an inch of the shoot above the ground. I gave them the common advantages of new planted things, and watered the bed at times.

MAY 27, I examined these ; they had all succeeded perfectly well ; they had taken good root, and shot about six inches in height.

MARCH 7, 1758, I repeated the experiment upon some shoots of the Pear-tree. I cut these off, in the same manner, at about a
foot

foot long, and took a piece of the old wood with each. I smoothed the ends, covered them with the cement, and planted them in the same manner in a bed in the nursery.

MAY 26, I examined them ; they had all shot about six inches in length, and had got very good roots. They are now so many very fine plants.

THAT this experiment might not be limited to the fruit kinds, I chose the common Elm for another instance.

FEBRUARY 6, 1758, I cut some shoots of the Elm in the same manner, with a piece of the old wood to each : I smoothed the raw ends, and covered them with cement, and planted them exactly as the others, in a bed in the nursery.

MAY 27, I examined the ground, and found they had all shot five or six inches in height, and were stout and flourishing plants, having all good roots.

THIS tends to confirm the general doctrine upon which these experiments were all established ; which is, that any part of a tree which can be preserved from rotting when in the ground, will send up a new plant of the same kind ; and that the danger of decay is not in any of the parts covered with the bark, but only in those which have been new wounded. It appears that the cement or dressing here directed, will preserve those parts ; and therefore that by its means trees and shrubs may be produced from all their parts.

I SHALL close this little work by a method not altogether of the same kind with these ;
but

but as it will succeed in several cases, where the common way fails, it may not be unworthy of the notice of Gardeners.

C H A P. VII.

A Way of raising TREES from the ROOT.

TO raise a new plant from the root of those kinds which will not take as layers, or grow from cuttings, I use this method : I lay open the earth over one of the roots of a thriving tree, of half an inch diameter, or more, according to the nature and growth of the tree : in small and tender trees, smaller roots will do. I raise this out of the ground, cutting it two-thirds through, and trim off all the side fibres for about six or eight inches of the root : then I dress all the wounded parts with the cement just warmed, and keep the wounded part of the root for about five inches length out of the ground, supporting it by a forked stick.

Thus it has the advantage of its own fibres, and of the general vegetation and growth of the tree, all the time that it is thus kept up above the ground. It has been said before, that the branches and roots of trees differ in nature no other way, than as the one are under ground, and the other in the open air ; and therefore this part of a root being raised into the air, what grows from it will be of the nature of a branch or shoot, not of a root. The Spring is the best season for doing this ; and if due care be used, it will always succeed.

There

There will be young shoots produced from the part that is in the air. These should stand till the next Spring to be well established, and they may then be cut off, and will readily and certainly succeed.

I HAVE raised in this manner plants of the Double Oleander, the Cotton-tree, and of several other kinds, the most difficult to be raised by the usual methods of culture.

THUS have I laid down what experience has shewn me, upon frequent and repeated trials, relating to the methods proposed by others, and used in my own practice, for raising valuable trees in abundance, and in an expeditious method; and I hope my brother Gardeners will find the advantage. They may indeed do much more; for though the experiments I have made amount to several hundreds, yet they have been limited to only a few species out of that almost infinite variety nature has thrown before us. These experiments may be easily repeated, in these kinds, and new ones may be made upon the same principles. Perhaps also the few I have made unsuccessfully, may, in the hands of some others, be crowned with success; for nature is very various; the event of experiments frequently depends upon little circumstances in particular cases which are not seen; and which, though they have prevented it in one place, may not occur in another. Even the Sensitive plant may, perhaps, rise from cemented cuttings under some other hand.

FINALLY,

FINALLY, the great question relating to the growth by leaves, is not yet decided. I shall with care observe, and mark again those which at the publication of this little work seem to give tokens of life, and shew some root. I shall also repeat the experiments on various other leaves, and hope others will join me in these trials. The thing seems strange; but who can say, what is, or what is not, in the power of Nature !

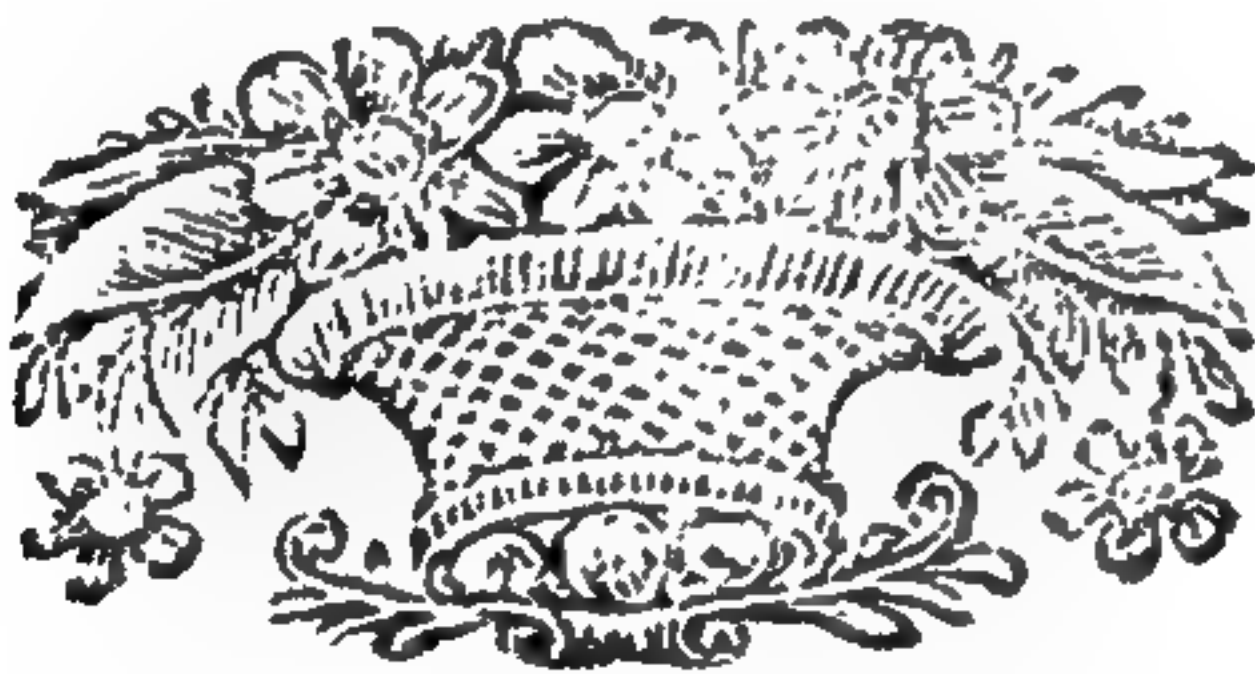
F I N I S.



E. S. L.

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THE
PRACTICE
OF
GARDENING.

By *T. PERFECT*,
A PUPIL of Dr. HILL:



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The PRACTICE of GARDENING explained.

INTRODUCTION.

BOOKS of GARDENING are tedious ; and difficult to be understood : and the best of them are very expensive. They are beyond the reach of many a working gardener who wishes to improve himself ; nor is it worth a gentleman's while, who raises a few flowers for his amusement, to purchase them : neither would it answer either his purpose, or the others, if they did.

THESE writers in general are obscure ; for two reasons : they do not chuse to reveal the true secrets of their art ; for they are not willing to make every body a gardener, tho' that is the pretence of their writing ; and even where they are willing to be more candid, they express themselves in such a manner that a common reader cannot understand them. They talk to those who want to learn the business, as if they had already understood it ; and therefore they are useless.

THIS is the reason why the practice of gardening succeeds so poorly, while it is pretended to be explained to every one : and for this reason the present short account is published : which contains the whole without reserve ; and is so plain that any body may understand it.

C H A P. I.

The Division of a PLEASURE-GARDEN.

A GENTLEMAN who has a pleasure-garden, should consider it under four articles. He is to have, 1. Hardy plants; and 2. Flowering shrubs; both which stand all the year in the borders: 3. Tender-annuals; which are to be raised in hot-beds, and brought into the common borders during summer; and, 4. Choice flowers, which are produced in seed-beds with great care, and afterwards planted in particular beds.

OF the first sort, or hardy plants, that stand the winter, are *Campanulas*, *French honeysuckles*, *Hollyhocks*, *Columbines*, *Sweet-williams*, *Wall-flowers*, and the like. These are to be raised from seed in a nursery, and brought into the garden the season before they are to flower.

OF the second kind, or shrubs, are *Roses*, *Honeysuckles*, *Lilac's*, or the like, which are to be raised from layers or cuttings, or from suckers, in the same nursery with the hardy plants.

OF the third kind, or Tender-annuals, are *French and African Marygolds*, *Balsams*, *Globe Amaranths*, and *China-asters*. These are to be removed from one hot-bed to another; till the season growing warm, and they gathering strength, they are at length planted in the borders; and thrive as if they had been raised there from the first.

OF the fourth kind, or choice flowers, are *Auriculas's*, *Carnations*, *Tulips*, *Anemones*, *Ranunculus's*, and the like. These are all perennial

and to have them in perfection, they must be raised from seed in a nursery, and in due time brought into the garden.

UNDER these four heads may be comprehended the whole practice of common gardening; and as each class of these has a particular course of culture, the business may accordingly be divided into four kinds: 1. The raising tender annuals on hot-beds in spring. 2. The raising hardy biennials or perennials in the nursery in the open ground. 3. The management of choice and curious flowers: which differs no way from the former, but in that it requires more time and care: and, 4. The propagating trees and shrubs, by cuttings, layers, or suckers. He that knows how to do these four things, is qualified to take care of any common garden; and when he rightly understands the culture of one plant of either class, he will know how to manage them all.

ANY plant in the world is reducible to one or other of these four kinds; and therefore all gardening may be comprised within this moderate compass. Those who have extended it to large volumes, have delivered separately the culture of every species: but this is only repeating, many times over, the very same directions.

C H A P. II.

Of the Disposition of a GARDEN.

BEFORE the care of raising plants, there naturally comes the provision of a soil for them to grow in. The garden must have good mould,
and

and the proper conveniencies, else no art can give it beauty.

IF the borders be poor, bring in some old well rotted dung, mixed with some rich and fresh pasture mould, and a good quantity of that rotten earth which is found under old stacks of faggots. These should be well worked together, and then dug into the ground, in such quantity as may appear necessary : more when it is poorer, and less when it is something better.

LET the ground be open to the south, south-east and south-west, but well sheltered against the north and north-east. If former ill management has suffered trees or walls to those quarters where it should be open, let them be lopped, taken down or removed ; and if there wants shelter on the other sides, let it be given by a plantation of forest trees, or by walls.

THIS ground will feed and defend the choicest plants which bear the open air in our climate. The next requisite is water. Ponds must be sunk in proper Places ; and these should be shallow and clayed at the bottom. If nature has given such, it is very fortunate ; if not, they must be made. Any water will do that has stood some time in such places ; even pump-water itself : for it softens with the air and sun. In a ground of some extent, there should be two or three of these ; because the labour of carrying water to a distance is very great, and when gardeners neglect it, the plants never thrive.

ALL that is required farther, is a nursery, and a place for hot-beds. A piece of ground about

an eighth part as big as the garden, will serve for a nursery ; and one but half as big as that, will be sufficient for the other purpose.

The nursery should lie to the south-east, and be well sheltered from the cold quarters. It should be hid from the garden, because there is no beauty in it ; and there should be a little of the same enriching ingredients allowed to the mould in this place, that are used for the borders in the garden. It must not be so much ; because the plants will thrive better for being removed into a somewhat richer soil : but yet there should be some. It is a custom to let the nursery have a very poor ground, but that is wrong ; as extremes commonly are. Mr. *North* of *Lambeth* has a nursery where the soil is very rich ; and upon enquiry I find no plants succeed better than those which have been brought out of his ground. On talking with that experienced nurseryman, he gave me the following reasons : That if the seeds be sown in a poor soil, the first shoot will be weak ; and when they come to be removed out of the seed-bed into a nursery-bed, they are hardly able to get over the check of it : whereas if they are first raised in tolerably good ground, the original shoot is strong, and the power of vegetation soon gets over the check of that and the other removals. This is agreeable to reason, and he found it true in many years practice : so also have I. In short, such as the first shoot is, such the tree or plant will be ; and the old practice of keeping a nursery poor, is wrong. But moderation must be the rule ; and though the
mould

mould of this spot should be good, it must not be equally rich with that of the garden.

THE aspect determines where the nursery must be placed ; but the spot for the hot-beds must be chosen according to convenience. It should be a warm corner of the ground, near the borders, though hid from sight ; and it must be also near the stable, or the place from whence the dung is to be brought. The closer it is to the borders, the easier it will be to remove the plants with good balls of earth to their roots ; and they will always take the sooner, the better the old earth is preserved about them.

THERE is no piece of ground so small, but this division may be put in practice : and setting out right, all the rest will be easy.

THE ground being prepared, we may proceed to the four methods of culture by which the plants are to be raised.

S E C T I O N I.

The H O T - B E D Culture.

THE flowers we raise for the latter end of summer and autumn, are mostly natives of warmer climates, and their roots perish in winter. They are to be produced every year from seed ; and as our early weather is too cold for them, we are obliged to raise them with the assistance of heat and shelter early in the spring ; that they may be forward in the beginning of summer, so as to flower in autumn : and after having decorated our garden for the two latest months, may ripen their seeds before the frosts nip their roots. This is the reason of the hot-bed culture, which is to be performed in the following manner.

CHAP.

C H A P. I.

The making of the HOT-BED.

THE hot-bed is a bed of mould warmed by the vapour of dung, and covered from the air by a frame.

THE mould should be the same with that of the borders of the garden, but it must be skreened very fine. And the first care is this: In the month of January a sufficient quantity of this fine mould must be brought into the hot-bed quarter, and laid in a heap. There will be required for these plants a succession of three hot-beds; and there should be as much mould first laid in, as will be sufficient for them all.

THE frames are next to be prepared. The number and bigness of these must be proportioned to the quantity of plants intended to be raised; but care must be taken they are well put together; and that the glasses shut close upon them. This will bring on the time to the middle of February, and the dung should then be got ready, and the ground opened for the beds. Get in a good quantity of coal-ashes sifted, but not very fine, and save the cinders in another heap: then bring in three or four loads of dung, more or less, according to the ground. Let it come with the litter among it; and the wetter it is with the urine the better. Any dung of horses will do, but that of high-fed coach-horses is best. It should be brought directly from the stable into the ground. As this is wheeled in, some of the sifted ashes must be sprinkled over it. About

B five

five pecks to a load of dung should be thus added, and mixed in well among it.

WHEN all the dung is made up into a heap with this mixture, let it lye eight days to heat.

THEN mark out the place where the beds are to be made. Dig out the mould one spade deep in a long square, of the shape of the intended bed, and lay that away. Throw some of the cinders into the trench, and spread them even with a rake to cover the bottom about two inches: then lay in the dung upon this bed of cinders: take it up with a fork, and shake every forkfull as it is taken from the heap. By this means the longest stuff will come first; and the shortest, which is the richest, will be left for the last, to make the top of the bed. Spread the litter even, as it is thrown into the trench, and beat it down well at times with the back of a spade, to make the long stuff lie close and compact together. Raise the bed of dung in this manner about a yard high, and spread the small stuff which comes last, and is almost all dung, evenly upon the surface.

Then bring on the mould from the heap laid up for that purpose, and cover the dung five inches deep.

CH A P. II.

The Management of the PLANTS.

THE bed being thus finished, the frame must be put on, and covered with the glasses. Thus let it lie four-and-twenty hours to settle,

and warm the mould: then lay the surface perfectly level, and scatter on the seeds moderately thick: the Balsam, Amaranth, China-after, and French-marygold, with the several other kinds, may be all sown together; for the same management will raise them: but it is best to divide the bed into as many squares as there are kinds, by drawing slight lines over it, and in each square to sow one kind of seed.

WHEN the seeds are all in the ground, some of the same mould must be sifted carefully over them, till they are covered a third part of an inch. Some seeds require a little more depth than others; but this thickness in a hot-bed will answer generally for all. The glasses must be raised considerably in the day-time to let out the steam, and to let in fresh air, which is essential to the seeds growing well: in the night they must be shut down; but not quite close, unless the weather be very severe indeed: and even in that case they must be opened again in the morning. The warmth and moisture of the mould will soon bring up the plants, and then a new caution is required to preserve them.

WHERE they have risen very close, some must be pulled up. By this time the extreme heat and steam of the bed will be abated: The glasses may be kept close down all night; and there will require only a moderate raising of them for air in the warmest part of the day. Hot-bed plants require a different management at their various periods. In this state they must be kept pretty close, for they are in no danger of

being drawn up weak as yet ; and the seed-leaves require but little air.

WHEN the plants have a few days growth they will be fit for removing ; and there must be another hot-bed provided for them : this should be considerably larger than the first, because the plants must stand farther asunder. Let the bed be made up in the very same manner, and let it be covered, five inches and an half deep, with the same fine mould as the first. Cover it with the frame, and shut down the glass, and let it stand three days, that this thickness of mould may be thoroughly warmed.

THEN in the beginning of the afternoon remove the plants. Open small holes a finger's length deep in the mould, at three inches and a half distance every way from one another. Take up the young plants out of the first hot-bed with the point of a trowel, and immediately set them in this, one plant in each hole. Take care not to break the tender roots in taking them up ; nor to double or crush them in setting them in : bring the mould carefully about them ; and when they are all planted, give the whole bed a very light and careful watering : taking particular care not to beat down the plants : then close the glasses and leave them for the night.

ABOUT nine o'clock the next morning raise the glasses a little way ; at noon cover them with matts that the sun may not scorch up the leaves, and raise them a little higher ; toward evening wipe the wet off the sides of the glasses, that

that it may not fall back upon the plants, for it is always injurious to them.

IN this bed they must stand about three weeks ; and this must be their constant management : the glasses must be let down at night, and kept up always a little in the middle of the day. They must constantly be wiped before they are shut down for the evening ; and the degree of opening during the day, must be more or less according to the weather. The plants must have as much of the free air as they can bear without hurt, and the tender kinds will soon shew if there be too much allowed them. If the mould grow dry, they must be watered gently and carefully.

THE heat of this bed will decline gently at the end of about three weeks ; and there should, at that time, be some fresh dung laid to the sides of it : for the plants are to be removed from this hot-bed to another, and the mould of this must therefore be kept in some degree of warmth.

THE plants having been sown in the end of February, will be by this time of some strength ; the season will also be growing toward summer : another bed must be prepared for them about a week after the dung is laid about the old one ; and this will keep them till they can bear the air. This last hot-bed must be made in the same manner as the first, but with less dung and more mould. It must be considerably larger than the former, because the plants will require a much greater distance ; and there must be a depth of mould for the roots. The dung of
this

this bed should be about two foot in height, and the mould seven inches and a half deep.

WHEN it has stood covered one day and night, open holes in it at seven inches distance, and lay up the mould by the side. Take up the plants out of the former bed with large balls of earth about the roots ; and set them in this with a great deal of care. Draw the mould about them, and give them a gentle watering. Cover the glasses with mats, and raise them a little in the middle of the day, but keep them close at all other times till the plants have taken perfect root. Then let them be every day opened more and more at noon, and left open longer. If the plants be kept too close, they will run up weak, and be ill shaped. In this bed they must stand till the latter end of May, and all that time they must be watered frequently. The glasses must always be shut down at night ; and when the cold is severe, they must be covered with mats. The more air is let into them in the warm hours of the day the better.

TOWARD the end of May the hardier kinds may be removed out of this hot-bed at once into the borders of the garden ; chusing the evening of a mild day. Large holes must be opened for them, and they must be planted with great care. They must be taken up with a good ball of mould, and when they are planted again they must have careful waterings, from time to time ; till they are thoroughly well rooted in the ground.

THE removal of these out of the hot-bed will give more room to the tenderer kinds which require

quire to remain longer in it: these must be thin'd where they are closest, taking up every third or fourth plant; and setting these immediately again in the parts of the bed left vacant by taking away the others. The new planted ones must be watered frequently, and all the rest at least once in the Day. The glasses must be opened more and more every day, but the top shaded with mats when the sun shines upon them. After this hot-bed has been made and planted a fortnight, let some mowings of short grass, or any like matter, be piled up round the sides of the dung: this will bring on a new warmth and fermentation, when that of the dung begins to decline: and it will be enough for keeping up the growth of the plants, yet so moderate, that they will bear removing afterwards out of the bed without danger.

WHEN they have stood three weeks or somewhat longer in this bed, another parcel of them may be planted out into the borders. Chuse the hardiest of those which are now left; so that only the most tender and delicate kinds will remain in the bed. These must be taken up with more care than ever; because being larger, they will be apt to receive a greater check in the removal: a large hole must be opened for each, and the plant must be taken up with a great ball of mould, and planted without injuring the roots. They must be watered frequently after this, till they are thoroughly settled in the new ground: for if they get a check in their growth at that time, they never make good plants afterwards.

wards. Frequent watering is the great article, but the season may be a great advantage. The principal danger may be from the sun; therefore they must always be planted in an evening, that they may have the night for striking; and if a cloudy time can be chosen, it is much the better. The difference in this respect is so great, that they should be planted two or three days sooner or later, according to this accident.

THERE will now remain in the bed only the tenderest kinds, and it will be time to get these into pots. A sufficient number of small pots must be provided, and they are to be filled with mould from the first heap; the leavings of which having been now so long exposed to the air, will be much richer than the rest; and very fit to receive them.

TAKE up the plants carefully one by one, and set them immediately one in each of the pots. This may be done in the bed by lifting up the glasses. As each is planted, let the pot be set up to the very rim in the mould of the bed. The best method is to begin by taking up the plants which stand next one end, and then opening holes along that end to let in the pots as they are done; placing them close to the wood of the frame, and as close to one another as they can stand; and filling up the space between them with mould. This is to be continued till all the plants are potted; and if the pots be of a moderate size, they will in this manner fill the bed: there will be yet warmth enough in the dung to keep all in a due condition

tion for some time; and as this dies off gradually, the plants will be the more fit for the open air into which they are soon to be removed.

THEY must all be watered as soon as they are potted. This is to be often repeated afterwards; and they must be inured to the air. The glasses must be set open a great part of the day, but when the sun is violent, they must be shaded with mats. In this bed they must be kept till the middle of July, defending them by the glasses from the cold of the nights; and giving them more and more air every day, till at length the glasses are to be taken entirely off in the middle of the day, when the weather is cloudy; and at last kept off entirely.

WHEN the plants have borne this some days, they will be in a condition to remove into the air; but this must yet be done with caution. A warm and well-sheltered spot in the nursery should be chosen for them, and the earth dug away a spade depth. The pots must be brought out in a warm cloudy day; and it will be best of all if there be some rain. They must be set up to the rim in this bed, and the mould laid in close among them. They must be watered every day; and they should stand thus a week. Then the pots may be exposed to the air by setting them upon the surface of the ground; and after this they may be set out in the places where they are to flower.

THEY must be watered every day, and they will now want no more care.

THIS is the method by which all annuals may be raised to their greatest perfection. Less care is usually taken, and therefore they succeed the worse: But this is not much. A little trouble will serve a great many plants, and they will answer it very well in their beauty.

Two things farther are necessary; 1. The care of their flowering; and, 2. A provision for seeds. Both are too much neglected in common practice. Let the best plants be marked for seed; and let these be managed purposely for it. They must only be suffered to open ten or a dozen flowers: and when these are well set for seed, all the rest that offer must be taken off in the bud. These plants must be watered very often, but never a great deal at a time: and when the seed is formed, and has got its due size, they must be set against a south wall where they can stand quiet; and they must then have no more waterings. When the seed is thoroughly dry and hard, it must be gathered and kept for the next spring. If this care be taken each year, the stock will increase every season in beauty.

THOSE plants, which are intended only for bloom, must be treated in a contrary manner; they must be watered largely once a day, and no more: and all the flowers, as they begin to fade, must be taken off with a pair of sharp scissors. This keeps the root in vigour. For nothing exhausts it like letting them set for seed and the taking off these before that time, will produce more and more fresh bloom. When the season grows cooler, they must be removed
into

into a place of shelter to keep them in blow as long as that can be. When the frost seizes the mould they will decay : but they will thus be preserved longer than could be thought in beauty, and will produce four times the quantity of flowers that they would have done if managed in the common manner.

THERE is nothing in this that a gentleman, ever so much unused to gardening, may not direct a common labourer to perform : and these are the flowers which make the shew of autumn.

S E C T I O N II.

The Culture of BIENNIAL and PERENNIAL hardy Plants.

PERENNIALS are such plants as keep alive in the root during winter, and when once planted, are supposed to need little more care : but they may be made to flower much more elegantly with a little attention. The BIENNIALS perish when they have flowered, tho' they are two seasons in coming to that state. The same culture serves for both.

OF the hardy perennial kind we have named the campanulas, hollyhocks, and several others. The moth-mullien is a biennial.

THE seeds of these will all shoot in the common ground ; and they are all to be sown in the same manner. Therefore this second culture may all be delivered in as moderate a compass as the first.

C H A P. I.

Of preparing the GROUND and sowing the SEED.

CHUSE out a piece of the nursery that lies a little flanting from north-west to the south-east, and is very well defended from cold winds. Let it be of the common mould of the place; that is, of the same nature with that of the garden, but not quite so rich. Turn it up in ridges all winter, and in the beginning of March lay it all level; let it be well dug and raked, and then tread up a path along the middle, and divide the ground on each side into beds four foot and a half wide. The extent of this spot must be proportioned to the garden; but in this one place, and with one and the same care and management, may be sown and raised all the common hardy perennial and biennial plants.

In the middle of March let the seeds of the several kinds before named, and of any others that may be desired, be sown in this manner. Chuse one or more beds for each, according to the quantity intended to be raised, and rake off about half an inch of the surface; then in the evening of a calm day sow them thus: Mix with the seeds three times as much fine sifted and dry mould; it will make them spread the more evenly. Sow them by hand with this mould pretty thick, and when the surface is regularly covered with them, sift over them the mould that was first raked off from the bed. This will cover them a third of an inch, which will
be

be perfectly sufficient. When the seeds are covered, lay two or three pieces of black-thorn bush upon the bed to prevent accidents ; and if in two days there does not fall any natural shower, water the ground. This must be done very gently, and the pot should have a fine pierced nose without flaws : for if the water run out in any part in a stream, it will wash the seeds out of the ground wherever it falls. The bushes need not be removed for this watering.

ALL the seeds of the biennial and perennial kind being sown and sheltered in this manner. The waterings must be repeated if the season is dry ; and when the plants appear, the bushes should be lifted off the ground. They will not be wanted any more ; they have kept off accidental injuries, and mellowed the mould, and this was all that was required.

WHEN the plants have a little strength, they must be thinned, by pulling up such as are weakest, where they stand too close ; and they must have water whenever they want showers. This must be managed with great care ; for if the plants are injured now, they do not well recover it ; and a heavy watering may bruise them, or wash them out of the ground. They shoot up only leaves at present, for the stalk does not appear till the next year : but the rudiment of it is formed already ; and if it be injured, the plant will never be fine afterwards. As the plants grow larger they must be thinned again, taking up always the worst. The seed was ordered to be sown pretty thick for this purpose, that there might be choice of the best to leave for growth.

IF there be very sharp winds when the plants first come up, and the ground is not well defended by its natural situation, a reed-hedge should be set up to defend those which are in most danger: and if hard frosts happen which break the ground about the new-rising plants, a little mould must be sifted over to cover them again; removing it with a finger when it would bury the heart of the plant.

Thus the danger of the early spring will be got over, and all the rest will come very easy. The plants must be weeded carefully, and the showers of April will water them.

IN the beginning of May they must be transplanted; and for this purpose a bed must be dug up and levelled, much larger than the first. The evening of a mild day should be chosen for this purpose; and if the weather be showery so much the better: the gardener may very well wait for this opportunity, since a few days sooner or later, will make no great difference.

Holes must be opened for them at different distances, three, four, six, or eight inches, according to the bigness of the plants. The roots must be taken up carefully, and immediately planted, and the mould must be drawn closely about them, and settled by a good watering.

DURING the summer the ground must be weeded as often as any growth of that kind is seen upon it. And some of these weedings may be done by hand, but one or two should be with a trowel; breaking up all the ground between the plants at the same time that the weeds are destroyed.

IF any of the plants send up stalks this first summer, they must be cut down close to the ground, for it is not their flowering season, and they will be weak and poor. The roots are to strengthen themselves in the ground this season, and nothing more is required of them.

IN the beginning of October, let more ground be dug up for them, and let them be there planted at a greater distance. About twice the number of beds the plants already occupy, will be needful for this service: the ground must be dug up a full spade deep, and holes opened for the reception of the plants at double the distance of those in the former bed. An evening of a mild day should be chosen for the business, and the plants carefully taken up, each with a ball of earth. The extreme fibres must be trimmed when they are brought to the new ground, and they must be directly set in, and the mould closed about them.

GIVE them a slight watering that evening, and a large one the following morning: take off the large outside decaying leaves, and the rest will thrive the better. When the weather comes on severe, lay more thorn-bushes lightly upon the beds, taking care not to crush down or wound the plants; and in the depth of winter, when there are hard frosts without any snow, spread some pea-straw over the thorn-bushes; taking it off again when the weather is any thing milder.

C H A P. II.

The Management of PERENNIALS.

EARLY the succeeding spring make a draught of the several kinds of these out of the nursery-beds for the immediate service of the garden ; for the greatest part of them will flower this summer. In all quantities of flowers raised from seed, there will be some better and some worse, and no art can discover which will be good or bad, till the time of flowering is come : therefore for this first year the garden must stand its chance for good or bad ; but in the following seasons it will be supplied with certainty.

THE middle of February is the best time for making this plantation, for if it be delayed longer they will flower very poorly. With tolerable care there will be no fear of losing the roots when they are put in thus early. Let a mild day be chosen ; and if the season be very severe, let it be delayed till the extreme frost breaks : then mark the places in the garden where these plants are to stand, and open a hole for each a full spade deep ; and a foot wide. Take up as many plants as are wanted out of the nursery-bed ; bring as much of their own earth with them as can be done conveniently ; and set them upright in the holes with the head of the root a little below the level of the surface of the border : close the earth well to them, and sink a small hollow about the head of the root. The ridge of earth round it will keep off the bleak winds ; and if the weather should

should again set in severe, there may be a little bundle of dry pea-straw laid over each plant.

THE morning after the planting every one must have a moderate watering. At the time of planting there must be some given, but that must be very little. These plants will require afterwards no other care than is taken of every thing else in the borders, and they will flower strong and well.

THE great article is the care of those in the nursery; for the principal expectation is there. The beds must be kept weeded; and in very dry weather the plants must be watered. They will flower at their natural time, and the gardener will then know the value of the roots.

No plant should be suffered to blow more than four or five flowers this first season: this will be enough to shew their excellence, and they should then be cut down close to the ground for strengthening the roots. As they come into flower, the finest should be marked by thrusting a stick into the ground near the root; and such as are very poor should be pulled up and thrown away.

IN the beginning of October those roots which are marked for having borne fine flowers, should be taken up and brought into the garden. Large holes must be opened for these; and they must be taken up with balls of earth, and planted carefully. The succeeding year they will flower in their most perfect beauty, and the roots will have their full strength.

IT is this year also that the plants ripen the most perfect seeds, therefore the very finest should

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be marked for that purpose. The ripening of their seeds will weaken the roots, but it is needful for a supply ; and those which have been used for this purpose should be taken up, and others planted for the next year in their place.

Those plants which are marked for seed must not waste the strength of the root by too much blowing ; a few flowers will afford a sufficient quantity of seed, and it will be much better, than when the plant is loaded.

These must be well watered while the seed is growing to its bigness ; and after that they must have very little ; and for the last days none.

When the husks are quite dry, the plant should be cut up, and laid entire on a shelf in an airy room to harden. After a day or two the seed-vessels must be taken off and laid separate to dry a week : then the seeds should be shook out ; and these should again lie about ten days. Thus they will be perfectly cured ; and they should then be put up for winter. The following spring they should be sown exactly in the manner before directed ; and this should be the course from year to year.

The old roots will flower very well two seasons more, but not equal to the first bloom ; and much less to such as shall be produced from the seeds of these. With the management here directed, the stock will be every year improving ; and a very small piece in the nursery will supply these articles to the garden.

C H A P.

C H A P. III.

The Management of BIENNIAL PLANTS.

THESE agree so entirely with the perennial in all respects, excepting only their duration, that the same management exactly serves them, all but in the last transplantation. They are to be raised as the others by seed sown in spring; and they are to be in the same manner transplanted out of the seed-bed into a second piece of nursery-ground; but they should be brought in time into the garden. If these plants be kept all the summer in the nursery-bed into which they were transplanted from the seed-bed, they will many of them flower in the nursery, which is not intended; for they are not strong the first year, nor is the nursery a place for the flowering of those plants whose roots perish. To prevent this there requires one transplantation more the first year for these than for perennials.

WHEN they have been raised in the same manner with those, and in the same manner transplanted out of the seed-bed into another part of the nursery, they must not be suffered to stand there till autumn, but brought into the garden during the forepart of summer. They will naturally be removed out of the seed-bed in May; and when they have stood about five weeks in the new ground, it will be proper to take them into the garden. This must be done with care; and it will secure their continuing without a stalk till the next year. Toward the latter end of June let a cloudy day be chosen,

and open, in the borders of the garden, as many holes as there are plants. Take them carefully up with a good ball of earth to the root, and fix the new mould well about them. Give them a good watering ; and repeat it every day : they will strengthen themselves by this means during the summer and the winter following ; and having had eighteen months growth before they flower, they will blow in the greatest perfection. Few who are not accustomed to the arts of culture, can imagine the advantage of this method : I had the good fortune to see it two years ago in a very remarkable manner in the case of the common mothmullien in a garden near *London*.

THIS is a wild plant in some parts of England, and produces under the hedges a long spike of handsome yellow flowers ; but in the way I saw it raised, it exceeded in beauty all the kinds we bring from abroad. Nature sows this plant in autumn, and it flowers the succeeding summer : the flowers ripen in July, and the seeds in August : these falling out as soon as the husks are dry, sow themselves in September, and the young plants appear in October, which flower the following July. Here is only a growth of nine months, from the first shoot to the flowering. But according to the method here proposed, we give the garden plants of the same kind eighteen months ; this is twice the time : the root has twice the strength, and the plant flowers with double beauty. The gentleman in whose garden I saw this plant in the summer of

of the year 1756, sowed it in the spring of 1755; the seeds were gathered from a wild plant the autumn before: they were sown in March, transplanted in May, and removed into the flower-garden about the middle of June; they flowered the July of the succeeding year. The flowers were as big as a crown-piece, and of a yellow that exceeded the ranunculus. Every body admired the plant till they heard it was an English weed: and probably the seeds of these fine plants will raise a yet more beautiful progeny.

S E C T I O N III.

The Culture by SUCKERS, LAYERS, *and*
CUTTINGS.

NOTHING could be more natural than that part of gardening which multiplies flowering shrubs by the suckers that rise near their roots: nature indeed makes the increase unfisted; the gardener only removes the new plant to another place. This was the first way of propagation introduced into our Shrubberies; and from this came the other two. Where shrubs did not afford suckers, it was natural to try whether a branch buried in part in the ground, would not take root in time; and serve as a sucker: This was tried, and it succeeded; and thus came in the method by layers. Long after this Lauremberg proposed the way by cuttings. People thought him mad for saying a piece of twig stuck into the ground would grow; but they found it true on trial; and it is by far
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the most useful method of all. As it is not universal, the others must on some occasions be still employed. We shall therefore propose them in their natural order.

C H A P. I.

Of Propagation by SUCKERS.

MANY of our flowering shrubs, and other kinds, send out a number of young shoots from the root, which would make, as it were, a little thicket about them. These are a deformity to the original tree, and they suck in that nourishment which should go to feed its flowers and foliage. Therefore they ought to be cleared away, though they were not wanted: but they are every one capable of growing into a new shrub.

THE best time of propagating shrubs this way, is the middle of October. Suppose there is an old lilac in the garden, and that it is surrounded, as is naturally the case, with suckers, in October dig up a small piece of ground in the nursery, and open with a spade large holes at two foot distance every way, laying up the mould at the side of each hole. Then in the evening of a mild day take up all the suckers from the old plant, and chuse as many of the finest as are desired to be raised. The best are those which are straightest and thickest in proportion to their height; and such as have grown farthest from the stem of the tree: cut off the ends of the roots, and plant one in every hole, first throw-

ing in a little of the loose mould from the side to make a good bottom. Drive in a fence-stake pretty close to each, and let it stand a foot and half out of the ground. Plant the sucker just as deep as it was naturally where it rose from the old root, and tie it to the stake in two places with some soft matting.

Thus plant the whole number intended, and then give them all a thorough watering. Repeat this every other day for a week, and they may then be left to nature. They will strike root during the remainder of the autumn, and will be found full of life in the following spring. All the care they will require farther is, to keep the ground weeded between them, and in very dry seasons to give them some water. They should stand three years in this bed, and they will then be fit to plant in the garden. To this purpose they must be taken up at the same season, that is, late in autumn; the fibres trimmed all about the roots, and in planting the mould must be well settled round them by careful laying in, and by a good watering. A stake should be also thrust into the ground to tie them up; and if the weather be severe, the first winter some dry peas-straw should be laid about the roots; and kept down by pegs. This is the whole culture by suckers; and thus very fine plants may be obtained from many kinds of our shrubs; but not from all: therefore other methods are also necessary.

C H A P. II.

Of propagating SHRUBS by LAYERS.

WHEN shrubs do not yield suckers, and will not take by cuttings, recourse must be had to laying. This may either be done from the branches of those shrubs which are kept for flowering, or from such as are planted for that purpose only ; and are called stools.

THIS latter is the practice of nurseries where great numbers are to be raised for sale : the other is more the purpose in a gentleman's garden.

THERE are two seasons for this work, the beginning of autumn, and early in the spring : the first is best for hardy trees, and particularly for those which hold their leaves all winter ; the latter for the generality of the other kinds.

IF the gardener has any of the more elegant flowering shrubs, which he intends to increase, the best method is by layers : and it should be done in this manner. Chuse out some of the branches which grow near the ground, or such as can be bent down to it with the least violence ; and which have such a length that they can bear to be in part buried five or six inches deep, and have a piece of half a foot in length left above the ground at the end. Draw these down in the manner they will come most naturally to the ground, and make a mark along the part at which each lies ; mark also the part of the branch that will be under ground in the laying.

laying. Then open as many trenches as there are branches to be laid, carrying them straight along where the marks were made ; and opening each a full spade deep : let the mould be very rich ; and well broke in the working. Let the trench be five inches deep all the way. Give each branch a slight twist in the middle of the place where it is to be under the mould. This must be done in so careful a manner, as just to crack the rind, and no more. Then with a sharp penknife slit the branch thro' in the same place for an inch and half in length. Cut some hooked pegs to keep it down. Bring down each branch in a careful manner till it touches the bottom of the trench opened for it ; and peg it fast in that place with one, two, or more of the pegs, according to the danger there is of its getting up by the spring of the wood : then cover in the mould, pressing it moderately close about the branch with the hand ; and to finish all give it a gentle watering. The next day water it somewhat more largely ; and after this give it only the common care of the other plants. The end of the layer that is left out of the ground, will shew whether it continues in health ; and all that is required more, is keeping the place well covered with mould ; and in the dry time of the succeeding summer watering the ground at times : in the winter there will be very little need of this.

ONE year will serve in general for the giving them good roots. If the branches have been laid in autumn, they may be taken off from the old
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tree the autumn following; and planted in a nursery-bed if they be slow growers; or if not, they may be at once set in the garden where they are to remain. Roses laid one autumn, and the layers taken up the next, will flower the succeeding summer; and so it is in many other kinds: but according to their natural flower growth others require more time.

If layers be desired from some curious shrub which has no branches near the ground, the method is this: Fix upon one or more of the branches for laying, and by pulling them gently down with the hand, observe how far they will naturally yield; then set up a tressel under each branch, and place upon it a trough of wood a foot deep, filled with very fine mould. Let the tressel raise this so high, that the branch can easily be brought down to it; and raise as many of these as there are branches intended to be laid. Then twist and slit every branch as before directed; and lay it down in the trough so that it may be covered five inches with mould, and leave a piece of a foot long standing out. Fasten this down with sticks thrust across the trough, and cover the branch with mould.

This must be watered more regularly and carefully than layers in the open ground, because the small quantity of mould in the box would otherwise quickly dry. The success of the whole depends upon keeping the earth moist: if it should be suffered to grow dry, even after the layer had shot roots, they would wither. If the care of watering be observed regularly, these
layers

layers will succeed as well as those in the common ground ; and at the end of one year they may be cut off from the old shrub, and planted in pots, or in the open ground, according to their kinds. This method extends the propagation by layers to almost all kinds of shrubs and trees ; and when it is well managed, it will always succeed.

C H A P. III.

The Method of propagating by CUTTINGS.

TH E benefit of the method by layers is very plain ; but the operation is tedious and troublesome. This has introduced the short and easy practice of raising shrubs from cuttings : and wherever it will succeed, it is greatly preferable to that by layers ; because less time and trouble are required, and a much greater number may be raised this way than can the other.

NOT only shrubs and trees, but all plants which have woody stalks, may be propagated by this method. It may be done almost at any season of the year ; but the best time is in May and June, that the cuttings may take root so as to be fit for removing before winter. There are few kinds which, being managed with care, will not succeed in this manner. All cuttings require shade and water ; and the more tender they are, the more perfectly they must be sheltered. For the common kinds a small bed in the nursery, hooped over and covered with canvas, will answer very well. The more delicate will require to be covered with hand-glasses, or

to have the assistance of a hot-bed. Those which will not strike by one of these ways, usually will by another; and there are very few that will not one way or other succeed.

In the middle of June let a piece of the nursery ground be dug up very well, and make a bed of three foot broad, and of such length as may hold the proper number of plants: have some hoops ready to place over the bed, and a piece of canvas to cover them: it must be so large as to cover the hoops entirely, and to fall over to the ground at each end. Then take cuttings from all the shrubs and plants intended to be propagated, in this manner: Chuse the straitest, evenest, and most vigorous young shoots of the several kinds, and cut them off about seven inches long. Clip off the leaves from the lower part of each, and twist the bottom of the shoot: then with a fine awl pierce the bottom of the stalk thro' in several places up to an inch and half in height.

PLANT these two inches and an half deep in the mould of the bed, at a small distance from one another; and continue till the whole number intended are in the ground; close the mould very well about them, and give them a good watering. Plant the hoops over the bed, and lay the canvas upon them; covering them entirely: thus let them stand the first night. In the morning lift up the canvas at one end, and along the sides, a little way from the ground; and keep it raised by bricks or pegs, that the plants may have some air but no sun. In the evening
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lift off the canvas, and give them another watering.

THIS practice is to be continued ; only giving them more and more air from time to time, till they have taken root. The mould must never be suffered to dry about them, nor must they be exposed to the sun ; but the more air they have, after some days, the better. In this manner they will take root in six, eight, or ten weeks, according to their kinds : and then the greatest hazard is over : but they must still be shaded from the sun in the middle of the day, and watered frequently. In the beginning of September they must be transplanted, and they must then be removed according to their different degrees of tenderness or hardiness, into pots, or at once into the open ground : or by a milder course into warm nursery-beds that will raise them to more strength. It will be best to begin with the most tender. These must be potted : and for this purpose as many small pots must be prepared as there are of those plants, and filled with mould. The cuttings must be taken up one by one, and great care must be taken to take up a good ball of earth with each. They must be planted upright, one in each pot ; the mould must be carefully closed about them, and they must be set in a warm sheltered place, and shaded from the sun by a canvas, or other contrivance. Here they must stand the winter ; and as spring advances, they must be taken out of these pots, with the whole ball of earth, and planted in larger. The method is this : Have a
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set of larger pots ready, with a heap of good mould ; put a little of the mould into the bottom of one of the pots, and shake out the whole ball of earth in one of the small pots ; trim the fibres round the surface, set the ball upright in the larger pot, and fill in the rest with more of the mould. Change the pots of all the plants in this manner, and set them in the same place : shade them from the sun in the middle of the day, and water them constantly every evening. After this they will be soon established into good healthy plants.

THIS is the whole management of the tender kinds, which are kept in pots always, as Geraniums, and the like. A second sort are such as require shelter while young, but will bear the open air when grown up to some strength. Of this kind are the Cistus, called the Rock-rose, and the like. These should next be taken out of the bed, and they must be managed just as the former set ; only that in the succeeding spring, when the others are put into larger pots to be kept for good ; these are to be planted out into the borders. They must be taken out of the pots with the entire ball of earth, and planted upright with care ; fastening the stem to a small stake thrust into the ground to keep it steady. They must be well watered till they have taken root, and they will then need no more care, but will grow up into good shrubs.

THE third kind, which are hardier than these, but not absolutely suited to our soil as natives, should be next taken up and removed into a nursery-

nursery-bed. Of this kind may be reckoned the hardy shrub St. Peter's-wort, and some others. When the plants of the two former classes are removed out of the first bed, a place must be prepared for these: they need not have pots; but only require a good spot of open ground. Look out a shady and perfectly well sheltered part of the nursery, and dig up a bed a full spade deep, breaking the mould very fine. Open holes in this at five inches distance every way; then take up the plants each with a ball to its root: place one in every hole; and keep them perfectly well watered till they are established in the new ground: then leave them to nature. Only if the winter should prove extremely severe, shelter them a little in the worst weather.

In spring take them up with large balls of earth to the roots, and plant them in the garden in the places where they are to remain, watering them constantly till they are new rooted.

LAST of all take up the plants of the fourth or hardiest kind, and plant them at once in the borders. The *Althæa Frutex*, and some others, are of this kind. Let holes be opened in the borders where they are to stand; take them up one by one with good balls to the roots, and plant them in these openings: water them every day till they have taken root, and they will succeed without farther care.

HERE is a plain and easy method by which a garden may be stocked with all the kinds of flowering shrubs almost without expence. Cut-
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things may be had from any garden ; and one bed raises them all : they are all to be transplanted from thence at one time ; and the same method of culture afterwards raises them to perfection. Thus easy is gardening when the principles are once perfectly understood.

S E C T I O N IV.

The Culture of the choicest FLOWERS.

LAST of all we are come to the management of the most elegant productions of the gardener's art : These depend for their excellency upon the same principles of culture, tho' more time and care are required in raising them ; than the other kinds : And it has appeared most proper to treat of them last, because they will best be understood after the others.

THE common gardener is content to raise these flowers from off-sets, or from parted roots ; but this deprives him of all possible means of improvement. There requires time in the raising them from seed : but the trouble is very little ; and this is the way by which new kinds are obtained. We propose taking off a great deal of the trouble of gardening, and yet directing the reader to the full knowledge of the art. We shall therefore give the plain method of raising these elegant kinds from seed, and bringing them to their highest perfection : and this method is so far the same for all the several kinds, that one care, and one piece

piece of ground, may serve for the whole collection.

THE flowers of this kind may be reduced into two classes; 1. the fibrous, or tuberous; and 2. the bulbous rooted. The first kind comprehends Auricula's, Ranunculus's, Anemones, and the like: the latter Tulips, Hyacinths, and those others which have grassy leaves. The culture of each of these flowers is delivered separate by those who have written on this subject hitherto; and a different kind of mould is directed for the reception of each seed; but I have found that one kind of earth serves them all, and one method of culture.

C H A P. I.

Of sowing choice FLOWERS.

PRE P A R E the mould for these flowers thus. Pare off the turff in a dry piece of rich pasture ground, and dig up the mould as deep as it goes; this is usually one full spade's depth: take care to go no deeper, and not to mix any of the bottom with it. In the beginning of March dig up five loads of this; mix with it three loads of river mud, one load of old cow-dung, and the same quantity of rotten mould dug up where an old faggot-pile has stood. Sprinkle over this four bushels of slack-ed lime, and a pale-full of brine made of a peck of salt.

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The quantity may be larger or smaller, according to the number of plants intended to be raised ; but this is the best proportion : let it be all well work'd together, and thrown thro' a coarse skreen ; and thus let it lie till May : then turn it very thoroughly again : it will also require another turning in July ; and this will compleat it for service.

PROCURE seeds from some person on whom you can depend ; they must be saved from the finest flowers that ripen any, for some of the very finest do not ; and laid carefully to harden. Each parcel must be put up separate, and laid by till the latter end of July.

THEN chuse a part of the nursery which is open to the south-east, and skreened from all other quarters : dig away the mould, make up beds with that which has been all this time preparing for that purpose, and mark them number 1, 2, 3, and so on. Each must be a yard wide, four inches deep in mould, and laid a little rounded. When these are all ready begin sowing. Rake off an inch of mould from the surface of the first bed ; mix some of it with the seed intended to be sowed, and scatter it on evenly in the evening of a mild day. From the seventh to the seventeenth of August is the best period for this service. Sift on as much of the mould that was raked off, as will cover the seeds a third part of an inch, and lay a piece of thorn-bush upon the bed. Thus far it is the same with the method of raising the common perennial plants. It was before observed,
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that the difference is only in point of time and care. Sow every seed in this manner, and finish all the beds.

THE seeds of these choice flowers are usually sown in pots and boxes; and the common writers on gardening give that direction. I have tried both, and find the open ground is best. The earth dries too fast in these small parcels; and the seeds grow better when they have the vapours from the open ground.

ONCE in three days water the beds in this manner: Lift off the bushes, and lay a piece of old matting over the bed. Water upon this lightly and carefully, and when the wet has got through lift it off, and so water the next. The ground will thus be moistened without disturbing the seeds. If gentle showers fall naturally, these waterings may be omitted; but if heavy rains come on, some mats or cloths must be laid over the beds upon the thorn-bushes, to keep off the violent force of the drops.

A VERY small piece of ground will answer for this, and therefore the care is easy. Writers direct a different time for sowing the several kinds, but this season with this method suits them all.

THE young plants will appear at various times, but the dangers to which they are exposed are the same, and one kind of protection is required for them. No weed must be suffered to grow upon any of the beds. When the plants rise very close, some may be pulled up and planted in a more vacant place. When

rains fall heavy, mats must be laid over the thorn-bushes; and as the frosts come on, the same care must be used to guard against them. In severe weather the beds must be kept covered up entirely; but when it is milder, they must have the free air of the middle of the day. Towards spring a reed-hedge must be set up to the north-east of the beds to keep off the nipping winds from that quarter. Thus they will be kept till the beginning of the spring; and they must then be gently watered at times; and if the noon-day sun appear to have too much power, they must be shaded from it.

Thus all the kinds will be kept in good condition till about June the next year; and at that time the *Auricula's* and *Polyanthus's* which retain their leaves, must be transplanted. Another bed like the first must be prepared for them, and they must be set at four inches distance one from another. They must be watered carefully, and shaded till they have taken root. After this no more is required than to keep the ground clear from weeds; and thus they will be gathering strength till the next year.

THESE being removed, the other beds must be examined. The leaves of the young *Anemones*, and the rest, will now be decayed; they must be clipp'd off, and the surface of the bed laid smooth, and a little of the same mould sifted over the whole: about a third of an inch in thickness. Thus they must remain till autumn, keeping the surface clear from weeds. At
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the beginning of October sift another new coat of mould over them, of the same thickness with the former, and take the same care of the beds this as the former winter: only as the plants are stronger, it need not be so strict. The plants which have been removed into the nursery-beds must also be sheltered during severe weather in the depth of winter, and the surface of all the beds must be kept clean from moss.

Thus far the culture of all these plants is the same; but as some of them are afterwards to be taken up at certain seasons, and treated in a manner different from those whose leaves remain all the year, it will be proper to consider their management in the rest of their growth, under the three distinct heads of the fibrous, tuberous rooted, and bulbous plants: for according to this distinction of the roots, the management of them varies in the succeeding time.

C H A P. II.

The Management of FIBROUS-ROOTED choice FLOWERS.

OF this kind are the Auricula and Polyanthus Primrose, with the like: the root consists of fibres, and therefore does not admit of being kept any time out of the ground. On this depends the particular management of these plants.

THE raising all the kinds from seed being alike, that has been directed already. What

we here call their farther management, regards their flowering. The Auricula being the most excellent of these, its culture may serve as a direction for all the rest : the principal difference between this and the Polyanthus, is, that the Auricula is kept in a pot, and the other in the open ground.

THE Auricula seed has been sown in August, the young plants have been removed in the June following, and are now, we suppose, in the nursery-bed into which they were set at that time. They are to remain there till the following spring, and the greater part of them will then flower. They will not blow fine, because they stand close ; but it will be easy to see which will make another year the best flowers.

THE plants, in this nursery-bed, may now be distinguished into three kinds ; 1. Those which have good flowers ; 2. Those which have ordinary and indifferent ones ; and, 3. Those which yet shew no bloom. Many of these last will prove the finest of all. Mark the several sorts with three kinds of sticks, and thus let the bed remain till the middle of July ; then manage the plants according to their value. First take up all those which have borne ordinary flowers, and plant them out in the borders of the garden. Then prepare as many pots as there are plants which have borne fine flowers, and take these plants up carefully with a ball of their own earth : plant them in pots of the same mould, and give them a gentle watering. The
plants

plants which have not yet flowered, may now be left in the bed without removing : they will stand the more free and clear for this taking away of the others ; and they will gather great strength the succeeding spring.

THE beds must be kept clear from weeds, and the mould sometimes broke between the plants : if the autumn prove very dry, they must at times be watered ; and a mat may be drawn over them in the severity of winter.

THE plants in the borders require only the common care of every thing else that is in the same place ; but those which are potted must be managed more delicately. Set the pots under the shelter of a wall, or building defended from the north ; and let there be a shed carried over them to keep off rain and too much sun. Here let them stand all winter. In the middle of February bring in a quantity of the same mould, pare off the surface of the earth in all the pots an inch deep, and fill up the place with this, giving them now and then gentle waterings. If the frost be severe after this, there must be a canvas drawn from the edge of the shed to the ground, in front and at both ends. This must be let down in an evening, and taken up two hours after sun-rise.

THUS they will be preserved in the bud, and they will flower in perfection. When they blow they should be removed to a stage of shelves one above another, and open to the south-east.

SOME

SOME will now appear less valuable than was expected ; and let these be put into the borders of the garden. Others will be much finer ; These last must be marked for increase. Seed must be saved from them for another sowing ; and the off-sets carefully removed and planted in other pots, where they will make so many good plants. The time for taking these off is the beginning of April ; and they must be managed just as the others.

THE roots left in the nursery-bed will now flower, and the best must be marked. These must be put into pots the July following, and the others planted in the borders of the garden. This is the whole culture of the Auricula ; and thus all the fibrous-rooted choice flowers are to be propagated.

C H A P. III.

The Management of TUBEROUS-ROOTED FLOWERS.

THE Anemone, Ranunculus, and some other kinds, have roots of a thick solid substance, and irregular shape, nourished by fibres. These are called tuberous roots. They contain the rudiment of the plant which is to flower the next year ; and they have so much substance to defend it, that they may be safely taken up after the flowering season in spring ; and kept in a dry place till autumn. This gives
an

an advantage to the flowers ; and on this depends their particular management.

WE shall here take the *Anemone* for an instance. The seeds were sown in August with the others ; the young plants took their growth together the first spring, and they have been refreshed and sheltered by a new coat of mould in summer, and by a second in autumn. There we left them, and we are now to pursue their particular management. They must have some shelter if the winter be severe, and in spring they will shew themselves above ground in larger and much stronger leaves than the first.

DEFEND them well from the north and east ; give them gentle waterings, and many of them will flower. Mark the roots into three kinds, as the *Auricula's* : 1. Those which promise fine flowers ; 2. Those which seem indifferent ; and, 3. Those which have not flowered.

WHEN the bloom is over, the leaves will soon decay. Toward the end of May they will be in a manner gone : then look over the bed, first taking up those roots which were marked for fine flowers : clip off the remains of the stalk and leaves, and wash off the mould, and spread them upon a piece of canvas stretched above the ground in an airy room, where there is no sun.

NEXT take up the roots of the more indifferent flowers, and clean and dry them in the same manner. When they are very dry, put them up in separate parcels, and keep them safe till autumn.

G

LEAVE

LEAVE those roots in the first bed which have not yet flowered.

IN the middle of September make up two beds of the same mould, raise them five inches above the surface, and round them at the top. When the mould has lain a week to settle, dig it up again, level the surface as before, and plant the roots; the fine ones in one of these beds, and those of an inferior kind in the other. Plant the roots two inches deep, opening the surface for this purpose with the point of a trowel; and cover them carefully with the mould. They should stand at five inches distance one from another.

IF the winter should be very severe, the beds must be sheltered in the worst weather. In spring yet more care is needed, for these roots, being planted early, will soon shoot for flower; and nothing is so injurious as frost, or sharp winds to the bud. There must be hoops placed over the beds, and canvasses drawn over them in the bad weather. They must now and then have the benefit of watering, and always be open to the noon-day sun, which at this early season will have no power to hurt them. They must only be covered in bad weather, for the more air they can have safely, the better they will blow.

It will be now seen which are the finest flowers, for there is no certainty in the first blowing: not that the finest of the former year will grow worse, but many of the second bed will shew themselves much better than they promised.

promised. No Anemone has its full strength till the second year's bloom, and no judgment can be formed of it till that time with certainty.

THE roots left in the feed-bed will this year also flower ; and they must be marked by two kinds of sticks ; and afterwards taken up and managed as the others.

THIS is the whole culture of the Anemone. Every summer the roots are to be taken up and dried, and every autumn planted. They will increase ; and the separated parts may be raised to flower like the off-sets of Auricula's, or other plants : and thus there will be a continual enlargement of the quantity. But the way to raise new and fine kinds must be by sowing. Therefore as double Anemones do not ripen seed, it must be saved from the single ones ; many of these appear with the double ; and some of the best plants must be preserved for this purpose. The trouble of sowing is so little, that it may very well be repeated every year.

C H A P. IV.

The Management of BULBOUS-ROOTED FLOWERS.

THESE have a large roundish root ; composed of a solid fleshy substance, or of many skins one over another. The rudiment of the future plant is preserved so well in these,

that they may, as the tuberous ones, be taken up after flowering, and kept out of the ground till autumn. This is of the same advantage to the flowers as in the other instance; and the management is in a great measure the same; only the seedling plants are much longer before they flower. This makes the practice somewhat different. We shall select the Tulip for an instance.

As we directed all the seeds to be sown at the same time in separate beds in the nursery, we are to suppose Tulip-seed had its place among the rest. These seeds have been sown in August. The young plants will appear the following April like blades of grass; and these first leaves will fade in about five weeks. The surface of the bed should be then cleared of all young shoots of weeds or moss, and some fresh mould sifted on to cover it a third of an inch. In September the surface must be again well cleared of every foulness, and a new coat of the same mould sifted on of the same thickness. All this time, and all the following winter, the minute roots will be gathering strength. In spring they will again shoot up small leaves: these will fade as the heat of summer comes on, and then the roots are to be taken up. This must be done with care, for they are yet very small.

A NEW bed must be made for them, and this should be five inches thick in mould: the bottom should be the natural earth, well rammed, that it may be even and hard: the
roots

roots must be planted in this bed when they are taken out of the other, which will be about the beginning of July. They must be set at three inches distance, and covered an inch and half above the crown. At the latter end of September, a fresh covering of half an inch of the same mould must be given them, and the same early in the spring. After this the bed must be watered at times; the leaves will appear again in March, and fade about July: then a fresh coat of half an inch of mould must be laid on, and the same again in autumn. The next summer they must have just the same management; and in the summer of the succeeding year they must be taken up again.

THE roots having now four years growth, will be of some considerable size. A new bed must then be made for them just as the former, only two inches deeper in mould. They must be planted in this three inches deep from the crown to the surface, and they must stand six inches asunder.

THEY must remain two years in this bed, keeping the surface constantly clear from weeds, and giving them a new coat of mould every summer and autumn. This brings them to their perfection, and the next year they will flower. Some will blow sooner, but they will be the worse for it.

The roots must be taken up in the summer of this last year, and laid on a canvas to dry. They should be kept out of the ground till
autumn,

autumn, and then planted in beds of the same mould two foot deep, and rounded at the top: the roots must be planted seven inches deep, and ten inches distant from one another. The next year they will blow in perfection as to shape and bigness; but they will not come to the beauty of their colours till after one or more years of farther growth.

EVERY season the roots must be managed as already directed; and in every summer's blowing there will be some seen broken into stripes. These must be marked when in flower, and the roots separated from the others when they are taken up: they must be planted in particular beds; and they will make by degrees a fine collection.

THIS is the culture of the Tulip, the most delicate of all the bulbous roots: and thus that flower will be brought to its highest perfection. The time of its growth is long; but the trouble is very little.

F I N I S.

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